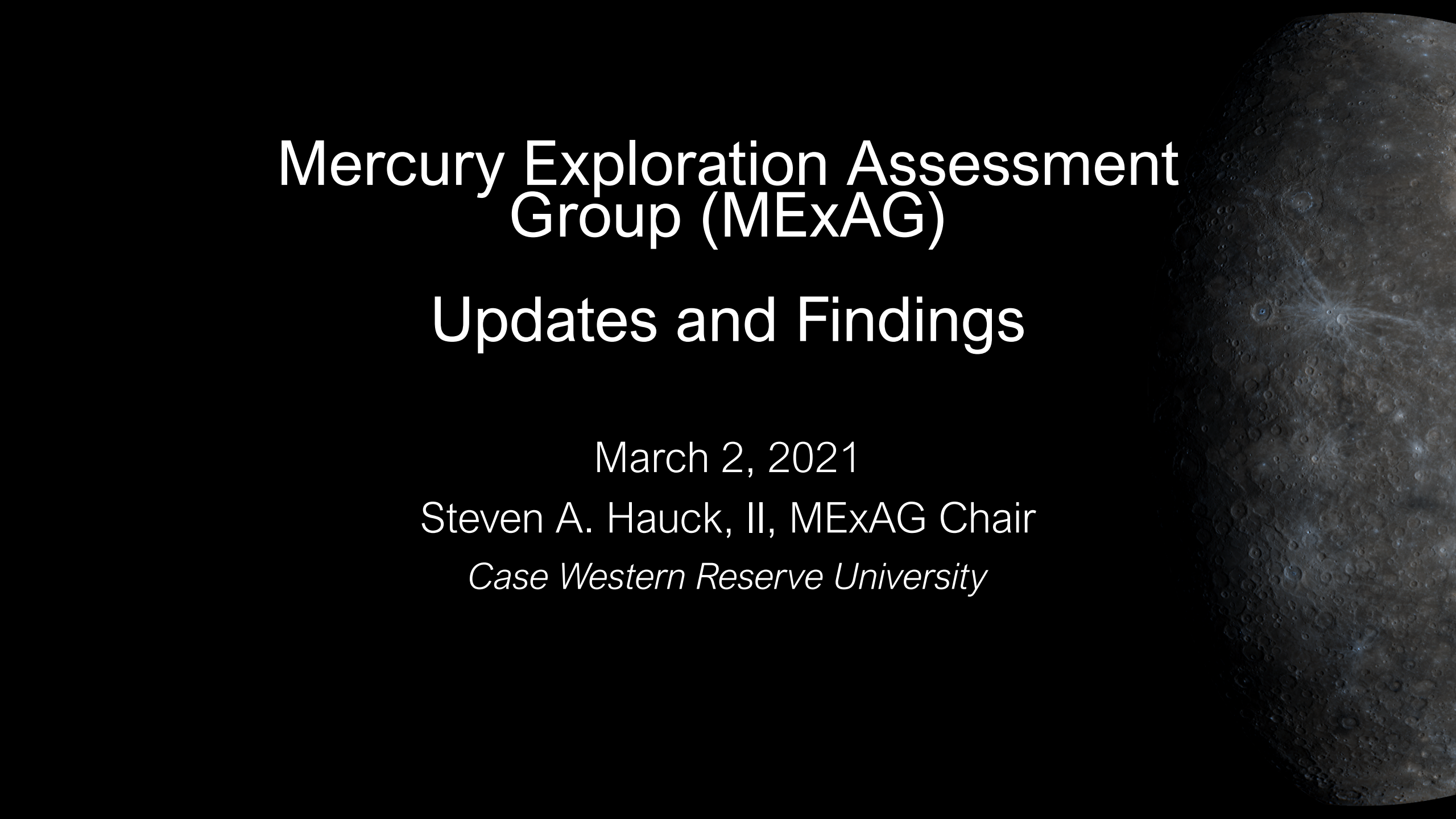
# Mercury Exploration Assessment Group (MExAG)

# Updates and Findings

March 2, 2021

Steven A. Hauck, II, MExAG Chair

*Case Western Reserve University*



# MExAG Steering Committee

Steven A. Hauck, II
Case Western Reserve U.
*Chair*

Carolyn Ernst
JHU APL
*Vice-Chair*

Ronald J. Vervack, Jr.
JHU APL
*Exosphere Discipline Member*

Kathleen Vander Kaaden
Jacobs/NASA JSC
*Geochemistry Discipline Member*

Christian Klimczak
U. of Georgia
*Geology Discipline Member*

Catherine L. Johnson
UBC & PSI
*Geophysics Discipline Member*

Gina DiBraccio
NASA GSFC
*Magnetosphere Discipline Member*

Ariel Deutsch
NASA ARC
*Early Career Member*

Gang Kai Poh
Catholic U./ NASA GSFC
*Early Career Member*

Suzanne Imber
U. of Leicester
*International Liaison*

Shoshana Weider
NASA HQ
*NASA Liaison*

# MExAG Annual Meeting Summary

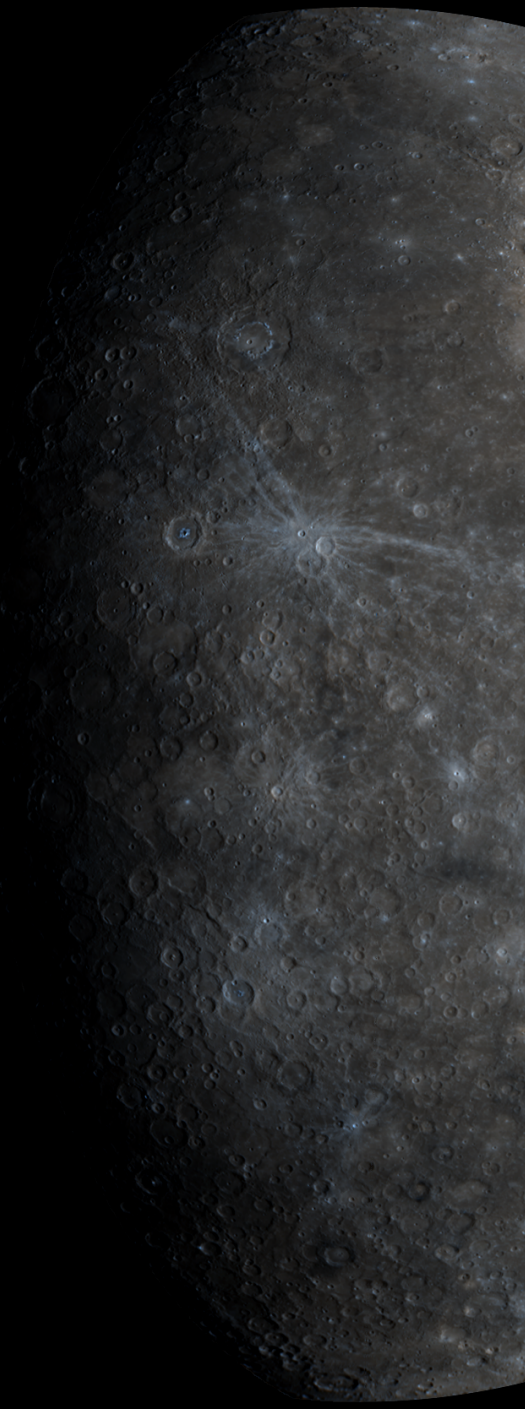
- February 3–5, 2021 [virtual] (3 hrs/day)
- >230 registrants, ~70% US/30% international
- >100 participants each day
- 58 presentations
- 3 additional sessions (2 early career, 1 networking)
- 7 findings
- Response to NF-5 Community Announcement
- Kick-off of Goals Document development

# NF-5 Major Parameters Response

- MExAG is concerned that the process of defining themes for the second NF call in a given decade lacks a mechanism for incorporating new discoveries
  - The cadence of NF and Decadal and Mid-term reports are such that there is a reliance on guidance written more than 10 years prior to the current call.
  - Given the NF-4 precedent, an important opportunity was missed in the Statement of Task for the CAPS [2020] report: an assessment of whether discoveries in the decade since the writing of *Vision and Voyages* merited other destinations being considered for NF-5.

# Findings Summary

1. Appreciation for creation of MExAG
2. PAC support for Mercury PMCS option
3. Cross-divisional mission support
4. Ground-based observation support
5. BepiColombo IDS/GI program
6. BepiColombo inclusion in DDAP
7. Early Career Support



# Finding: MExAG creation

1. MExAG expresses great appreciation to our colleagues at NASA HQ and in the PAC for supporting the creation of this Mercury assessment group.

   The Mercury community is vibrant and active, thanks in large part to MESSENGER and BepiColombo, but until now lacked an organized, community-based voice within NASA's planetary science community. MExAG is critical to the long-term support and strength of the Mercury community and for advocating for the continued exploration of the innermost planet. support of these activities.

# Finding: PAC support for Mercury PMCS option

2. MExAG appreciates PAC support for the inclusion of a Mercury mission concept study in the lead-up to the current Decadal Survey process.

   That finding addressed an important gap in the CAPS 2017 report Getting Ready for the Next Planetary Science Decadal Survey where the planet Mercury was mentioned only once—in the context of the Moon's polar volatiles.

   *MExAG encourages NASA to provide clear direction in its Statements of Task for future reports such that they assess priorities and knowledge gaps across the PSD portfolio and the previous Decadal Survey report*.

# Finding: Cross-divisional mission support

3. MExAG encourages NASA to enhance cross-divisional support for opportunistic mission science.

   NASA spacecraft often have opportunities within their cruise and primary operational phases to conduct science activities of primary interest to other NASA Science Mission Directorate Divisions.

   *MExAG encourages NASA to develop mechanisms for early identification and planning for support (i.e., planning and funding) of opportunistic science activities that serve communities outside the primary mission division.*

# Finding: Ground-based observation support

4. MExAG encourages NASA to facilitate ground-based observations of Mercury.

Despite their importance in Mercury exploration, such observations are often difficult to obtain owing to observational and facility requirements. Optical observations are vital for monitoring changes in the exosphere and radar observations are essential for geological and geophysical studies of Mercury, including investigating the polar volatiles and constraining its interior structure. Ground-based observations are also a critically important bridge between missions to Mercury.

*MExAG encourages NASA to:*

a) Work with optical telescope facilities on which NASA acquires time (e.g., Keck Observatory) and their Telescope Allocation Committees (TACs) to ease the scheduling of twilight-time observations for Mercury. Many telescopes require half-night or even full night proposals; however, Mercury is only available for 1-2 hours at the beginning or end of the night, disadvantaging observers of the innermost planet.

b) Engage with Goldstone and Green Bank Telescope, to ensure that there are equitable opportunities for planetary science observations, particularly now that Arecibo is no longer an option.

c) As the loss of the Arecibo Observatory planetary radar presents a significant loss in the scientific return of ground-based radar observations because it was several times more powerful and sensitive than other current facilities, we encourage NASA to participate in discussions regarding the future of Arecibo Observatory.

d) Allow observers to obtain letters of endorsement from NASA for Mercury observations in support of the BepiColombo mission during the upcoming flybys and orbital mission.

# Finding: BepiColombo IDS/GI program

5. MExAG expresses its appreciation to its ESA/JAXA BepiColombo mission colleagues for their efforts in expanding international cooperation by welcoming US-based investigators for the interdisciplinary scientist (IDS) and guest investigator (GI) programs for BepiColombo.

   MExAG also applauds NASA's current support of US participation in the ESA/JAXA BepiColombo IDS and GI programs and encourages NASA to support as robust a program as possible for the next expected call for IDS and GI proposals.

# Finding: BepiColombo inclusion in DDAP

6. MExAG appreciates NASA's inclusion of the analysis of BepiColombo data in the ROSES-2021 Discovery Data Analysis Program (DDAP) solicitation, which is consistent with past practice for Rosetta and the NASA contribution to BepiColombo. MExAG hopes to see continued and specified support for BepiColombo data analysis throughout the mission.

# Finding: Early Career Support

7. MExAG encourages NASA to expand upon existing opportunities for early career researchers to build a diverse and sustainable community for the future.

   These efforts are generally important for the community as a whole. However, they are of special relevance for diversifying and sustaining the Mercury community, as small communities such as ours are vulnerable to unintentional generational gaps because of infrequent missions. This effect is further exacerbated by the ongoing COVID-19 pandemic.

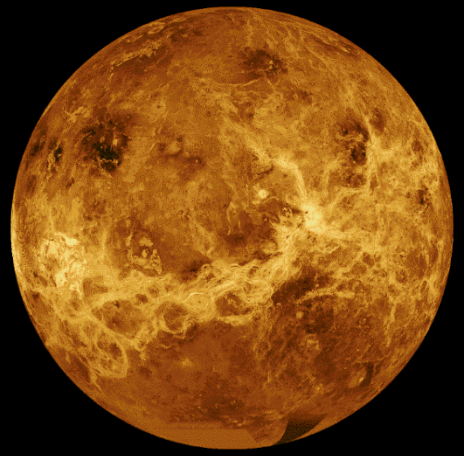
   Specifically, MExAG encourages NASA to sustain and grow the PI Launchpad, Planetary Science Summer School, mission science team meeting observing, and the Early Career Award programs.

   Efforts to further broaden and facilitate networking and mentoring opportunities for early-career researchers, including undergraduate and graduate students as well as postdoctoral fellows, within and beyond academia are encouraged.

# Upcoming Mercury Meetings and Events

- LPSC – 12 talks, 24 posters dedicated to Mercury
- vEGU – 19-30 April – Program to be posted
- MExAG Goals Document virtual town halls
- BepiColombo:
  - Venus Flyby 2, 11 August 2021 at 552 km altitude
  - **Mercury Flyby 1, 1 October 2021 at 200 km altitude**

MExAG: https://www.lpi.usra.edu/mexag
Twitter: @ExploreMercury

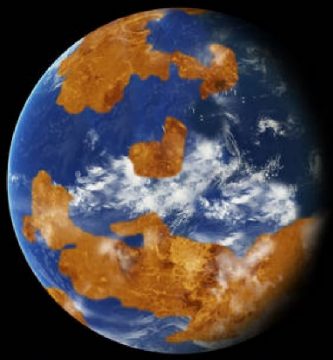


# VEXAG update
# March 2, 2021

VENUS EXPLORATION VEXAG ANALYSIS GROUP

| | |
|---|---|
| Darby Dyar | *PSI, Mount Holyoke College*, Chair |
| Noam Izenberg | *Applied Physics Laboratory*, Deputy Chair |
| Giada Arney | *NASA GSFC*, Early-Career Representative |
| Jeff Balcerski | *Ohio Aerospace Institute* |
| Paul Byrne | *North Carolina State University*, Early-Career Representative |
| Candace Gray | *NM State University*, Early-Career Representative |
| Natasha Johnson | *NASA GSFC* |
| Stephen Kane | *University of California at Riverside* |
| Pat McGovern | *Lunar & Planetary Institute* |
| Molly McCanta ** | *University of Tennessee* |
| Joseph O'Rourke | *ASU*, Early-Career Representative |
| Jason Rabinovich ** | *Stevens Institute of Technology* |
| Emilie Royer | *University of Colorado* |
| Jennifer Whitten | *Tulane*, Early-Career Representative |
| Colin Wilson | *University of Oxford* |
| Tommy Thompson | *JPL*, Scribe |
| Megan Ansdell | *NASA HQ*, ex officio |

VENUS



THE ORIGINAL OCEAN WORLD

| Name, starting | selection year | 2021 | | 2022 | | 2023 | | 2024 | | 2025 | | 2026 | | 2027 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1/1 | 7/1 | 1/1 | 7/1 | 1/1 | 7/1 | 1/1 | 7/1 | 1/1 | 7/1 | 1/1 | 7/1 | 1/1 | 7/1 |
| Darby Dyar - Chair | 2018 | | | Emeritus | | | | | | | | | | | |
| Noam Izenberg - Deputy | 2018 | | | | | | | | | | | | | | |
| Colin Wilson | 2018 | 1 | 1 | | | | | | | | | | | | |
| Pat McGovern | 2018 | 1 | 1 | 1 | | | | | | | | | | | |
| Candace Gray | 2018 | 1 | 1 | | | | | | | | | | | | |
| Joe O'Rourke | 2018 | 1 | 1 | | | | | | | | | | | | |
| Emilie Royer | 2018 | 1 | 1 | | | | | | | | | | | | |
| Giada Arney | 2018 | 1 | 1 | | | | | | | | | | | | |
| Jeff Balcerski | 2019 | 1 | 1 | 1 | 1 | | | | | | | | | | |
| Paul Byrne | 2019 | 1 | 1 | 1 | 1 | | | | | | | | | | |
| Jenny Whitten | 2019 | 1 | 1 | 1 | 1 | | | | | | | | | | |
| Natasha Johnson | 2019 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | |
| Stephen Kane | 2019 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | |
| Molly McCanta | 2020 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Jason Rabinovitch | 2020 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Siddharth Krishnamoorthy | 2020 | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| Sarah Port | 2020 | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| | 2021 | | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| | 2021 | | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| | 2021 | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |
| | 2021 | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |
| | 2022 | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| | 2022 | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| | 2022 | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | 2022 | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | 2023 | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 2023 | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 2023 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | |
| | 2023 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | |
| Totals | | 15 | 17 | 14 | 15 | 14 | 14 | 14 | 14 | | | | | | |

| VEXAG Monthly Meeting Schedule | |
|---|---|
| **Month** | **Activities*** |
| January | Review and approve Findings, submit to HQ. Two new members begin. |
| February | Plans for annual interAG meeting |
| March | Prepare for LPSC |
| April | Committee updates |
| May | Committee updates |
| June | Committee updates |
| July | Two new members begin. |
| August | Committee updates |
| September | Plan for annual meeting(s) |
| October | Review of CAPS and PAC presentations from Fall meetings; finalize planning for annual meeting; assign tasks for SC members at meeting |
| November | Annual meeting in person (Virtual 2020) |
| December | Review and vote on new Steering Committee members and committee assignment for the coming year. Plan for AGU Town Hall, if any. |

*Each month will begin with reports HQ Liaison (if any) and from the standing Study Analysis Workgroups and other current Venus-related bodies.

# VEXAG 2020

## The 18th Meeting of the Venus Exploration Analysis Gorup

- 100+ in attendance over 2 days
  - Primers, flash talks, posters
- New 6-month SC rotation established, with 30% early career investigators required at all times.
- Working with EDI group on standards
- Monthly Schedule for AG management
- Study/Science Analysis Workgroups (SAWs)

SAW 1: Organization Documentation
SAW 2: VEXAG 2021 Meeting
SAW 3: Exoplanets in our Backyard (2022)
SAW 4: VEGASO and LS Documents
SAW 5: Venus Science Nuggets
SAW 6: Surface Platform Study
SAW 7: Technology & Laboratory studies
SAW 8: Outreach/Advocacy
SAW 9: Social Media
SAW 10: Website revamp/Upkeep

# VEXAG 2020 Virtual Meeting

**OTHER VEXAG, community commitments, involvements, products**

- NExSS, Nexus for Exoplanet System Science
- ExoPAG Science Interest Group #3
- Equity, Diversity, and Inclusion Working Group
- AG Chair Caucus
- Venus Strategic Plan paper in review at Space Sci. Rev.
- Venus flagship study
- Venus Discovery Missions (site visit stage)

# Other Current and Upcoming

- No LPSC townhall

- VEXAG 2021: live at Caltech, November
- Exoplanets in our Backyard II:  live in 2022 TBD

- Optimism for Discovery, possibility of HOTTech 2
- AG budgeting
  - LPI and PSI have reached out to VEXAG for info
  - VEXAG's expected expenses

# VEXAG 2020 Findings I (work in progress)

1. VEXAG asks that U.S. participation in active international missions be maintained without compromising the high priority given to U.S.-led missions.
2. VEXAG urges NASA to consider that any mission that plans to fly by Venus take data there.
3. VEXAG requests that NASA make funding available for HOTTech 2, and provide additional funding to increase the selection rates for MATISSE and PICASSO.
4. VEXAG requests NASA consider leveraging the LLISSE development by offering LLISSE as a capability in the New Frontiers 5 Announcement of Opportunity.
5. VEXAG encourages NASA to restart the assessment and development of long-duration power systems for Venus (and other) surface applications.

# VEXAG 2020 Findings II (work in progress)

6. VEXAG requests detailed statistics on proposal submission and selection rates in all ROSES programs.
7. VEXAG requests that NASA augment the SSO budget to support dedicated Venus observations for suborbital & ground-based observatories (+Arecibo statement).
8. VEXAG requests that NASA establish a "seed" program in R&A, similar to STMD low TRL awards, to support high-risk / high-reward experimental proposals.
9. VEXAG requests Venus-related proposals continue to be included as part of the list of solicited research for the Habitable Worlds and Exobiology Programs in R&A, with specific language on which Venus-related science questions are sought for that program.
10. VEXAG requests NASA to provide funding for relevant Venus and comparative planetology studies as part of exoplanet programs.

# New Frontiers 5 Solicitation for Input

## Met with Curt Neibur, had extended discussions
## Sent letter to Curt and Lori Glaze 2/9/21

The announced New Frontiers 5 cost cap ($900M FY2022) renders many of the Decadal (Visions and Voyages) target themes handicapped or unachievable, especially those for Venus, and severely hinders a successful, innovative, and far-reaching New Frontiers 5 competition. **We strongly urge NASA to increase the NF5 cost cap to *at least* $983M in FY2022 dollars.** This value is based on the forward-inflated NF4 cost cap of $850M in FY2015, using an inflation rate of 2.15% for 2015–2021 and that same projected rate through to 2022. This value solely tracks with inflation, and does not represent any real increase in actual costs available to proposers.

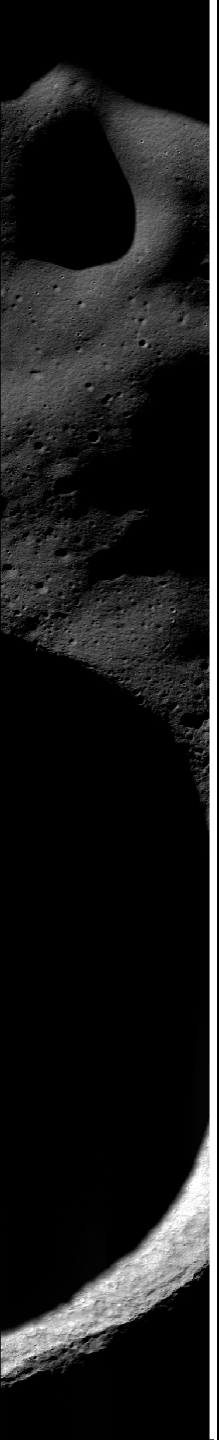
(2) Under any likely New Frontiers 5 cost cap, it is impossible to satisfy fully a majority (i.e., four or a preponderance) of the six objectives given for the Venus In-Situ Explorer (VISE) mission theme stipulated by the past two Decadal Surveys. At most, only one or two of the Decadal Survey Science Objectives for VISE can be realistically and reasonably achieved with the proposed NF5 cost cap – or even the increased cost cap we suggest, as demonstrated by high-fidelity budget estimates, including actual proposals and the NASA-funded Venus Flagship Mission (VFM) concept study report.

**Proposed NEW general text for NF5 AO:** *NASA recognizes that the science objectives of the above mission themes may include more scope than can be accomplished in a single New Frontiers mission within the cost cap. Those responding to this opportunity should choose among the science objectives above and defend those choices.*

*NASA does not prescribe how any missions or investigations responsive to the six themes should actually be accomplished. However, the required justification of the choice of science objectives should make clear why the set of selected science objectives addresses the science goals.*

**Proposed NEW text for NF5 AO specific to Venus:** *The Venus In Situ Explorer mission theme is focused on examining the physics and chemistry of Venus's atmosphere and crust by characterizing the detailed composition of the atmosphere, and the elemental and mineralogical composition of surface materials.*

**We ask that NASA specifically enumerate in the AO the number of objectives that must be satisfied and the extent to which they must be accomplished for each bullet for each destination.** For Venus, we ask that this requirement be at least one objective that is substantially addressed and at least one additional objective that is partially addressed.



# Lunar Exploration Analysis Group Updates

Dr. Amy L. Fagan, LEAG Chair

Presented to NASA Planetary Science Advisory Committee

2 March, 2021

# LEAG Community Excitement

- **CONGRATULATIONS to the Mars community on Mars 2020 Perseverance landing**
  - Increasing dialogs between Mars and lunar surface operators (past and present) including engagement at most recent Lunar Surface Science Workshop
    - e.g., "The Value of Integrating Science and Engineering Teams in the Operation of NASA's Mars Science Laboratory Curiosity rover." –Ashwin Vasavada

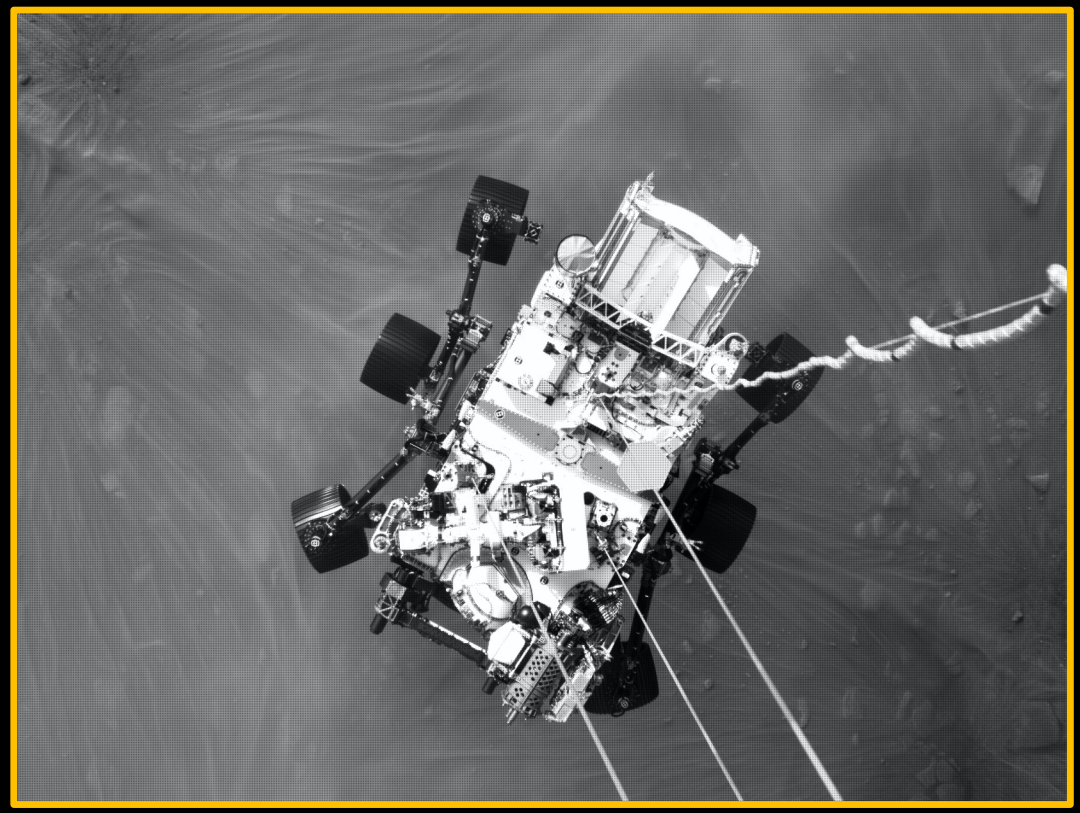
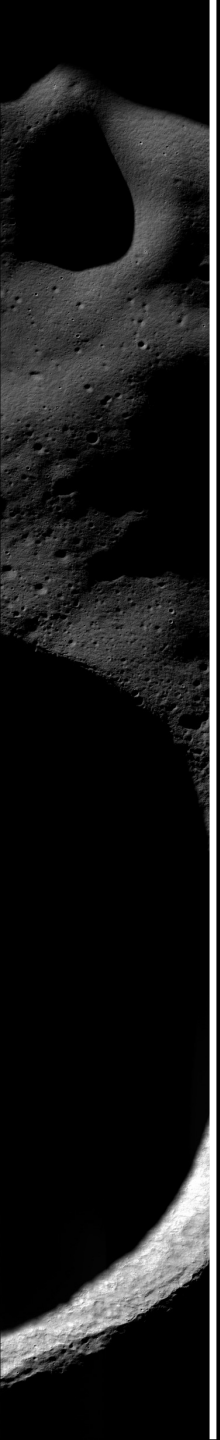


**Image Credit:** NASA/JPL-Caltech [Feb. 24, 2021 (Sol 4) local mean solar time 10:45:55]

Dr. Amy L. Fagan, on behalf of
Lunar Exploration Analysis Group

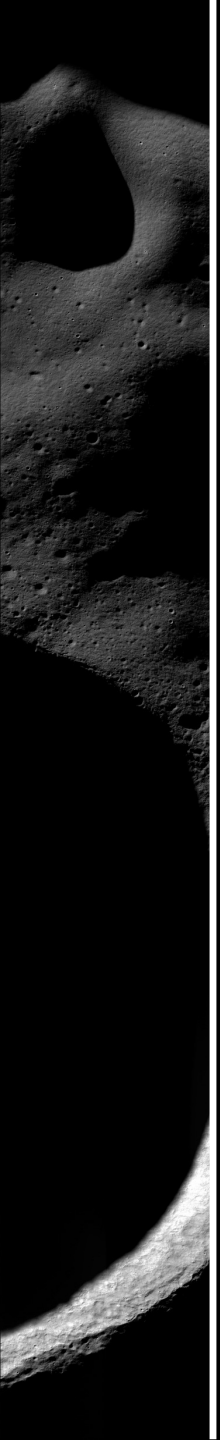
Given to NASA Planetary Science Advisory Committee

Tuesday, March 2, 2021



# LEAG Community Excitement

- **Artemis**
  - Prominent role of community documents in Artemis III Science Definition Team Report
  - Biden administration support
  - Eager to support implementation of program and see timelines for Artemis III and subsequent missions + Artemis Base Camp
- **Continued success and interest in Lunar Surface Science Workshop Series**
  - "an open forum for the presentation, discussion, and consideration of various concepts, options, capabilities, and innovations to advance scientific discovery on the lunar surface"
  - 8 meetings held with participants ranging 141-477 for first 7 + 558 registrants for #8
  - ~ Monthly cadence since May 2020
  - Reports available: https://lunarscience.arc.nasa.gov/lssw/
  - Community driven (LPI, SSERVI, chairs from NASA and non-NASA, early career facilitators)
  - Summer/Fall: Physical Sciences; Fundamental Physics



# LEAG Community Excitement

- **Progress towards several missions, technology investigations, new discoveries**
  - Lunar Discovery and Exploration Program
    - e.g., CLPS, PRISM, VIPER
    - Apollo Next Generation Sample Analysis
- **Encourage a Lunar Exploration Program Office similar to Mars Exploration Program Office**
  - e.g., recommended in 2017 LEAG Back to the Moon workshop outcomes report

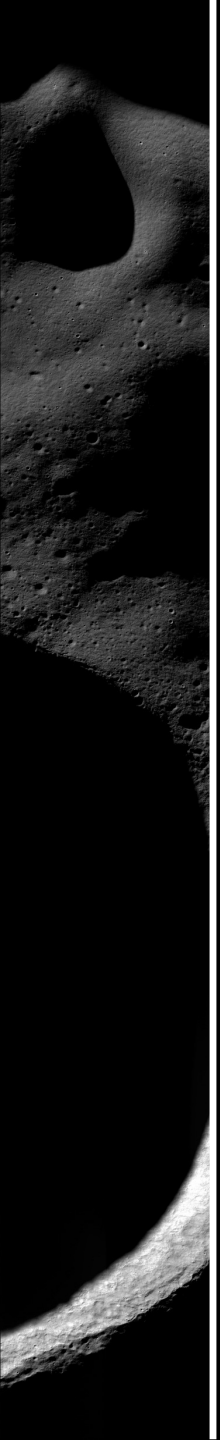
# LEAG Activities since December

- **New Frontiers 5 Town Hall (January 14,2021)**
  **https://lunarscience.arc.nasa.gov/nf5-townhall/**
  - Thank you to Dr. Curt Nieber!
  - 112 individual log-ins
- **Response to New Frontiers 5 Draft Announcement**
  - Regarding: Lunar South Pole-Aitken Basin Sample Return (pending Artemis landing site selection(s) and science objectives)
    - Determined to be highest priority science at the Moon for decades:
      Decadal Surveys 2003 & 2013; 2007 NRC *Scientific Context for Exploration of the Moon*; 2017 LEAG *Advancing Science of the Moon Specific Action Team*; Artemis III Science Definition Team Report (2020)
    - Uncertainties in Artemis Program
    - Capabilities of Artemis Architecture
    - Likely Artemis landing sites and site selection timelines

Dr. Amy L. Fagan, on behalf of
Lunar Exploration Analysis Group

Given to NASA Planetary Science Advisory Committee

Tuesday, March 2, 2021

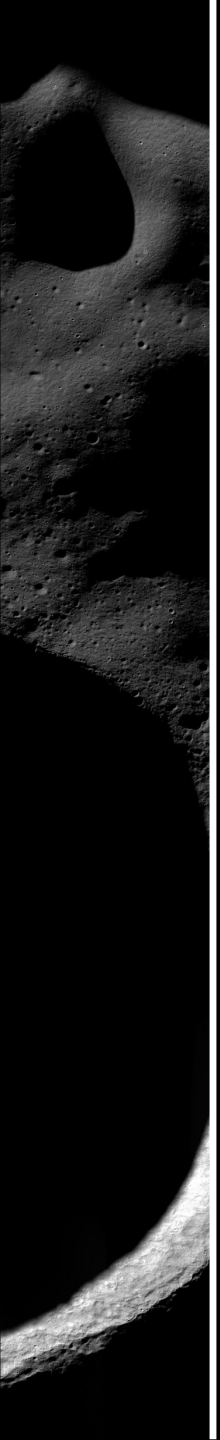


# LEAG Activities since December

- **EDI Prioritization Efforts: What can/should LEAG ExComm do?**
  - 3 main avenues:
    - Focus on what **WE** can do. Be a model for others.
    - Advocate for certain EDI efforts within the lunar community
    - Provide EDI services for the community
  - Selected first priorities: Code of Conduct; inclusive conferences (e.g., NF5 Town Hall)
  - Discussions ongoing, led by LEAG EDI Chair, Dr. Kristen Bennett (USGS)
- **Planning underway for 2021 annual LEAG meeting**
  - August 31-Sep 2, 2021
  - Virtual
  - Theme: Lunar Science and Exploration in the next 5 years
  - Engage and showcase the early career community

# Commercial Advisory Board Updates (1/2)

- **Leadership**
  - Chair: Elizabeth Frank (First Mode)
  - Vice Chair: Rafael Spears (The Aerospace Corporation, retired)
  - Executive Secretary: Sarah Deitrick (Jacobs / NASA JSC)
- **Membership**
  - Includes >60 individuals representing 38 companies, 2 financial firms, NASA centers, and universities
- **Accomplishments so far**
  - Engaging with membership to understand needs and pain points ✓
  - Rewrote charter ✓
  - Restructured organization to reflect growing membership ✓



# Commercial Advisory Board Updates (2/2)

- **Refined Goals**
  1. To serve as a resource to NASA and respond to requests from key stakeholders (including the PAC!)
  2. To report findings to NASA on the impact of the commercial sector of current or future NASA programs or policies and advocate for changes where needed
  3. To provide a forum for members and affiliates to coordinate activities, services, interfaces, collaborations, and supply chains
  4. To provide an interface between the commercial sector and lunar science community
- ***The CAB is available to respond to requests from the PAC***

- A Plug: Dr. Frank @ LPI Seminar Series May 6: Commercial Space Sector


**Bonnie J. Buratti, SBAG Steering Committee Chair**

March 2, 2021 NASA Planetary Science Advisory Committee (PAC)

Virtual Meeting

www.lpi.usra.edu/sbag/

# The Steering Committee

## Present Steering Committee

Elena Adams (APL), Technology Lead
Maitrayee Bose (Arizona State Univ.)
Bonnie Buratti (NASA JPL/Caltech), Chair
Michael Busch (SETI Inst.)
Terik Daly (APL), Early Career Secretary
Mike DiSanti (NASA Goddard)
Jessie Dotson (NASA Ames) Planetary Defense Lead
David Gerdes (U. of Michigan)
Mihaly Horanyi (UC Boulder)
Stefanie Milam (NASA GSFC)
William O'Hara (Sierra Nevada Corp.) Human Exploration Lead
Jennifer Scully (NASA JPL/Caltech)

Steering Committee selects Chair and Steering Committee members from among nominations, applications. General membership open.

# SBAG Representatives

Thomas Statler NASA Headquarters Liaison

Jake Bleacher Human Exploration and Operations Mission Directorate (HEOMD) Liaison

Paul Abell (JSC) HEOMD Observer

# What does SBAG do?

- Seeks broad planetary science community input on small bodies and missions to small bodies.
- SBAG TOR (updated this year) includes in SBAG's charter human and robotic exploration, fundamental research and analysis, resource utilization, and planetary defense; and lists all of the following as being in SBAG's bag: Main Belt Asteroids, Comets, Near-Earth Objects, Meteoroids, Interplanetary Dust and Meteors, Trojans (of all the planets), Centaurs, Trans-Neptunian Objects (TNOs), Dwarf Planets, small planetary satellites (including Phobos, Deimos, and the irregular satellites of the Giant Planets), and Meteorites and returned samples from any of these objects
- Holds open meetings twice each year for community participation; last one January 26-27, 2021; next one June 6-7, 2021
- Maintains a Goals Document.
- Makes findings: community-based concerns and issues and transmits them to NASA
- **Supports the Decadal Survey through white papers and presentations** 

# The SBAG goals document

## https://www.lpi.usra.edu/sbag/goals/

- New goals document posted February 2020
- New document preserves the three goals listed on the right.
- Technology and human exploration sections are included
- ISRU section will be updated in the next goals document

### Goal 1: Small Bodies, Big Science.

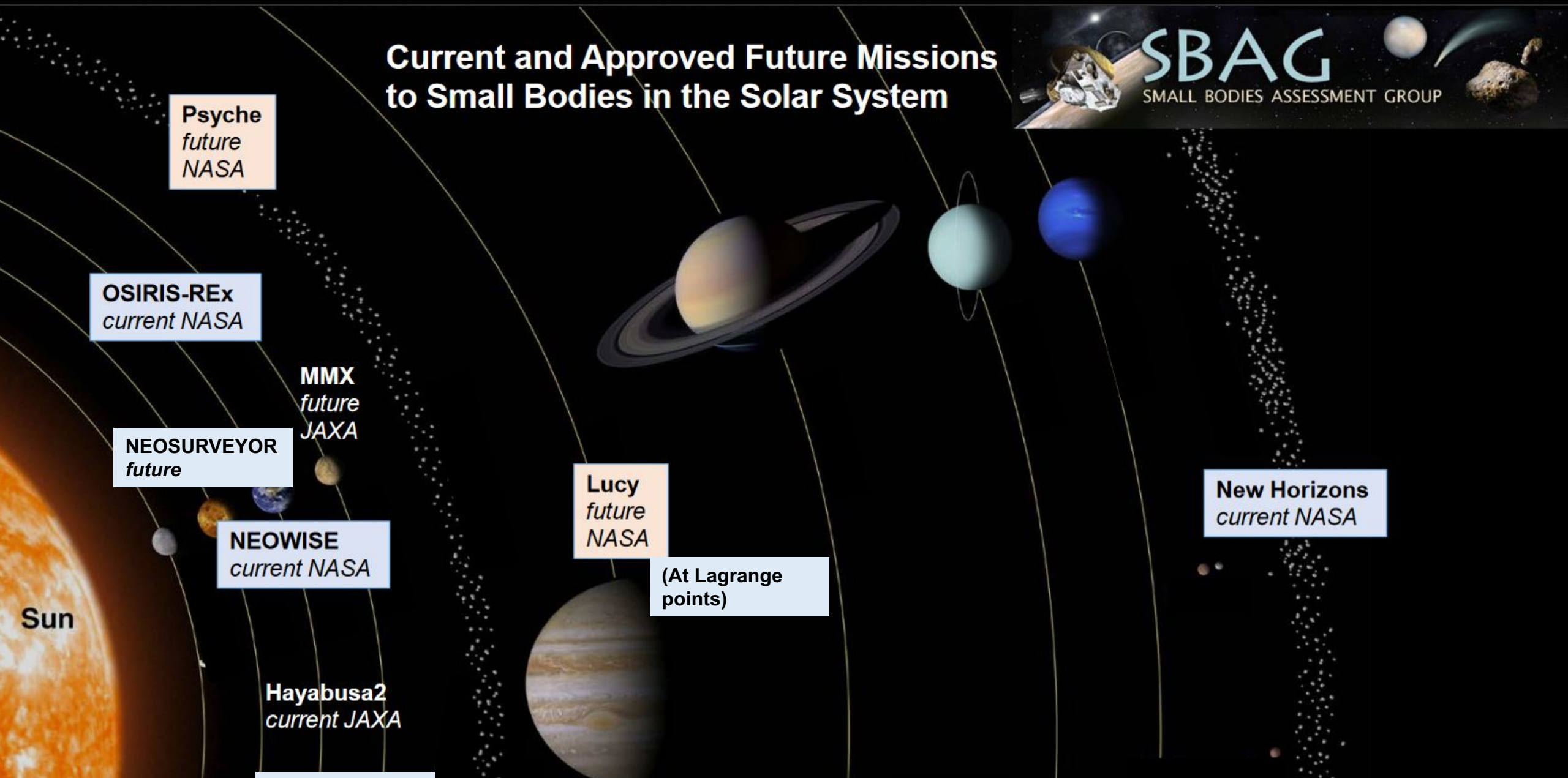
Investigate the Solar System's formation & evolution & advance our knowledge about the early Solar System conditions necessary for the origin of life through research & exploration uniquely enabled by small bodies.

### Goal 2: Defend Planet Earth.

Understand the population of small bodies that may impact our planet & develop ways to defend the Earth against any potential hazards.

### Goal 3: Enable Human Exploration.

Advance our knowledge of potential destinations for human exploration within the small body population & develop an understanding of the physical properties of these objects that would enable a sustainable human presence beyond the Earth-Moon system.


Current and Approved Future Missions
to Small Bodies in the Solar System
SBAG
SMALL BODIES ASSESSMENT GROUP
Psyche
future
NASA
OSIRIS-REx
current NASA
MMX
future
JAXA
NEOSURVEYOR
future
NEOWISE
current NASA
Lucy
future
NASA
(At Lagrange
points)
New Horizons
current NASA
Sun
Hayabusa2
current JAXA

# Highlights of of January 2021 findings (key ones that keep coming up)

1. **SBAG reiterates its support for a space-based near-infrared asteroid survey mission and expresses concern over the delay to KDP-B for NEO Surveyor.**

2. **SBAG recommends that NASA support additional asteroid radar observations at other facilities in order to meet a portion of the scientific and planetary defense goals previously accomplished by the Arecibo Observatory.** These steps are outlined in a white paper (https://www.lpi.usra.edu/sbag/documents/SBAG_RadarRecovery_20210217.pdf) (Summary follows these findings.)

3. **SBAG also recommends that NASA continue to consult with NSF and/or other relevant agencies about the Arecibo collapse and the process for deciding what happens next with the site, in order to ensure that the implications for NEO observations are adequately included.**

4. **SBAG applauds the transparent, full-community process conducted by NASA to confirm the targets that will be in scope for New Frontiers 5.**

5. **SBAG urges NASA to clarify in the PDART (or other relevant) solicitation that explicitly indicate that development of software tools to work with Solar System data from the Rubin Observatory are within the scope of the program or to add a solicitation specifically for Solar System science using Rubin data.**

**(Full text at https://www.lpi.usra.edu/sbag/findings/)**

# Highlights of of January 2021 findings (key ones that keep coming up)

6. SBAG encourages NASA to use resources at its disposal to identify the key science that can be addressed from the 2029 Earth flyby of asteroid Apophis, and to also investigate spacecraft and ground-based opportunities to support this event.

7. SBAG encourages NASA to continue exploring potential opportunities for cooperation with other US government agencies (e.g. NSF, Space Force, DoD, etc.) in the development of technologies and the operation of facilities relevant for planetary science, planetary defense, and space situational awareness

8. SBAG appreciates the lengths to which NASA has gone to soften the impacts of the COVID-19 pandemic on the community. SBAG appreciates the lengths to which NASA has gone to soften the impacts of the COVID-19 pandemic on the community.

(Full text at https://www.lpi.usra.edu/sbag/findings/)

**Table 1. SBAG's suggested improvements to current radar capabilities.** **(From the White Paper)**

| Facility | Description | Estimated additional cost to NASA | Comments |
|---|---|---|---|
| DSN: Goldstone | Increased radar observing time with GSSR and DSS-13 | Operating costs | |
| Green Bank<br>Phase 1 transmitter<br>Phase 2 proposal | NEO observations<br>Development of new transmitter | Operating costs<br>$30 million + | Collaborate with NSF |
| DSN: Canberra<br>Receive with Parkes (Australia) | DSS-43 80 kW klystron<br>New Parkes receiver | Operating costs<br>~$300,000 | Collaborate with CSIRO |
| Haystack | NEO observations with existing transmitters and receivers | Operating and startup costs | Operated by MIT, Lincoln Laboratory; requires proposal to NASA. |
| DSN: Madrid<br>Receive with Sardinia (Italy) | DSS-63 or DSS-53 transmitters | Operating costs | Collaborate with INAF |
| EISCAT UHF<br>EISCAT 3D (Scandinavia) | Available through 2025.<br>Buildup of new system; available after 2022. | | Encourage planetary radar observations by EISCAT consortium |
| TIRA<br>(Germany) | NEO observations with existing transmitter and receivers. | | Encourage planetary radar observations by Fraunhofer Institute, ESA. |

# Summary and future

- Next Meeting: June 6-7, 2021, virtual

- SBAG Findings are based on broad community input, represent the consensus of the community, and pinpoint persistent problems that need attention at the highest levels. Right now that is recovery of Arecibo NEO science

- SBAG Decadal work (detailed in backup slides)
  - Oversaw a collection of Decadal White Papers that represent broad science questions and community input.
  - Distributed and analyzed a questionnaire on research and mission priorities that was produced as a white paper.
  - “Supervised” (lightly) target papers, but not mission papers or technology
  - The Steering Committee  endorsed  some of the Decadal papers on Diversity, Inclusion, and Equity, and workforce and climate issues.
  - Prepared to assist the Decadal Committees in any way we are asked.

# Backup (Decadal work)

# Decadal Survey, summary of SBAG actions

- SBAG curated five  broadly supported white papers based on five “Big Questions” (next viewgraph, which in turn were based on our goals document.
- The January 2020 meeting included a workshop in which the community signed up for individual papers that covered the major small body targets.
- Specific mission white papers or technology white papers were not  organized by SBAG
- SBAG sent out a questionnaire to the community on science and mission priorities that was turned into a white paper.
- SBAG  intends to endorse a Diversity, Inclusivity, Equity paper, or other workforce or climate papers if asked. MAPSIT White Paper already endorsed

# Big questions for the Decadal Survey (based on goals document) that formed the basis of five SBAG-intiated White Papers

- What do small bodies tell us about the formation of the Solar System and the conditions in the early solar nebula?
- What does the distribution, composition, and sizes of small bodies tell us about the evolution of the Solar System, including its dynamical history, cratering processes, and the influx of volatiles and organics into the inner Solar System?
- Do sustainable habitable environments exist on any of the small bodies?
- What are the main geological processes that determined the evolution and current state of the small bodies and are they similar to those on larger bodies?
- What threat do Near-Earth Objects pose to civilization and life on Earth, and how can we quantify and mitigate that threat?

# Summary of white papers, cont.'d (see https://www.lpi.usra.edu/decadal/sbag/)

| Main White Papers Based on Scientifc Goals | Relevant Targets | Lead Author |
|---|---|---|
| **What do small bodies tell us about the formation of the Solar System and the conditions in the early solar nebula?** | KBOs; Small satellites; Comets; Asteroids; Interstellar bodies | Bjorn Davidsson (JPL) |
| **The Evolution of Small Body Populations: from Planet Migration to Thermal Drift Forces** What does the distribution, composition, and sizes of small bodies tell us about the evolution of the Solar System, including its dynamical history, cratering processes, and the influx of volatiles and organics into the inner Solar System? | All | Bill Bottke (SWRI), JJ Kavelaars (Dominion Astrophysical Observatory) |
| **Do sustainable habitable environments exist on any of the small bodies?** | Ceres; large KBOs | Julie Castillo-Rogez (JPL) |
| **What are the main geological processes that determined the evolution and current state of the small bodies and are they similar to those on larger bodies?** | All | Carol Raymond (JPL) |
| **The Future of Planetary Defense in the Era of Advanced Surveys**. What threat do Near-Earth Objects pose to civilization and life on Earth, and how can we quantify and mitigate that threat? | NEOs | Amy Mainzer (LPL) |

**Most of the other small body white papers, including ones on Main Belt asteroids, comets, dust, KBOs, interstellar objects, Centaurs, Pluto, and small moons, are also listed and linked at the above web site. Many were encouraged by SBAG during the January 2020 workshop. Copies of the submitted white papers are on the Academy website: https://www.nationalacademies.org/our-work/planetary-science-and-astrobiology-decadal-survey-2023-2032**

# The Questionnaire

Mark Sykes commissioned a SBAG-led questionnaire for the previous Survey. The questions covered missions and research priorities. The questions were updated by the current SBAG Steering Committee and distributed to the community. The results were submitted as a white paper.

**Summary:** SBAG surveyed the small bodies community for input to the Planetary Decadal Report. Seventeen questions on science and mission priorities were answered by 121 respondents. The highest priority scientific issues for small bodies were population identification and physical/compositional characterization; understanding the characteristics and evolution of individual objects; determination of the early conditions in the Solar System; and completion of the catalogue of PHAs. The highest priority flagship mission was a comet sample return followed by a Pluto orbiter/KBO mission. A comet sample return was also the highest priority New Frontiers mission, followed by a Ceres lander and a Main Belt multiple asteroid mission. Emphasis was also placed on the importance of ground-based and Earth orbiting telescopes (including radar), laboratory studies, and theory. The group also advocated preserving research funding over missions in the event of budget pressures.

Mars Exploration Program Analysis Group (MEPAG)

# MEPAG Report to Planetary Science Advisory Committee

*R Aileen Yingst, Chair*

*2 March 2021*

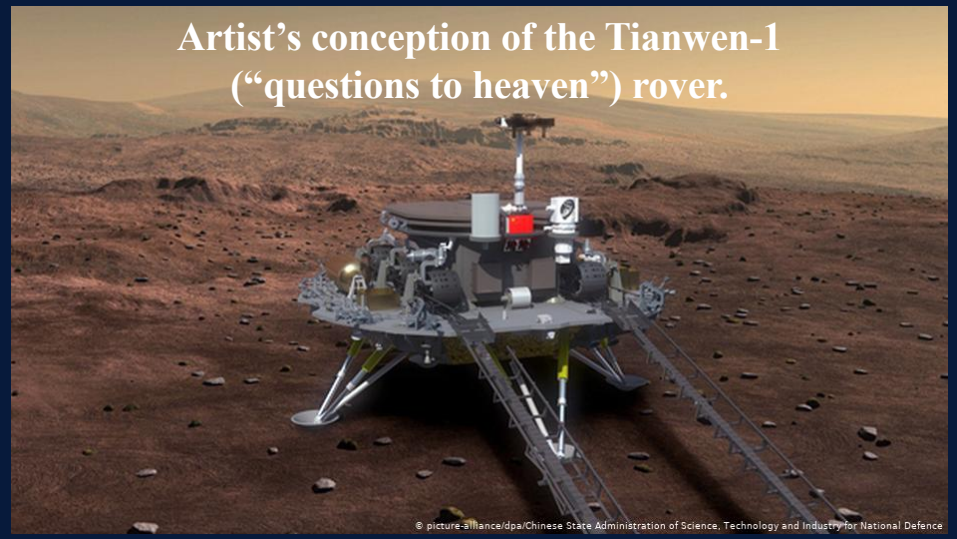
Perseverance Navcams 360-Degree Panorama: This panorama, taken on Feb. 20, 2021, by the Navigation Cameras, or Navcams, aboard NASA's Perseverance Mars rover, was stitched together from six individual images after they were sent back to Earth. Credit: NASA/JPL-Caltech

# MEPAG Programmatics

- Steering Committee (Chair: R. Aileen Yingst (PSI), appointed June 2019)
  - W. Calvin (Univ. Nevada Reno)
  - J. Eigenbrode (GSFC; rotating off)
  - D. Banfield (Cornell)
  - J. Filiberto (LPI; DEIA representative)
  - S. Hubbard (Stanford University)
  - S.S. Johnson (Georgetown University) ← New member
  - K. Lynch (LPI; DEIA representative) ← New member
  - J. Johnson (past Chair, JHU/APL)
  - M. Meyer (NASA HQ)
  - D. Beaty, R. Zurek (JPL)
  - J. Bleacher/P. Niles (HEOMD, NASA HQ) Ex Officio members
- Goals Committee (D. Banfield, Chair)
  - Goal I <*Life*> (J. Stern, GSFC; A. Davila, ARC)
  - Goal II <*Climate*> (R. Wordsworth, Harvard University (rotating off), D. Brain (Univ. Colorado)
  - Goal III <*Geology*> (B. Horgan, Purdue, Becky Williams, PSI)
  - Goal IV <*Human Exploration*> (J. Bleacher, NASA HQ HEOMD; M. Rucker, P. Niles JSC)

## Three successful arrivals to Mars!

- UAE Hope mission (Feb. 9 MOI)
- China Tianwen-1 (Feb. 10 MOI)
- NASA Mars 2020 Perseverance (Feb. 18 EDL)




**Artist's conception of the Tianwen-1 ("questions to heaven") rover.**


The UAE finished construction on its Hope spacecraft, bound for Mars, earlier this year. Image: © Government of Dubai Media Office.

**ExoMARS Rover/Surface Platform: Launch still planned (Fall 2022)**

# Recent MEPAG Activities

- MSR IRB report released Nov. 10, 2020
  - IRB had 44 Findings with 44 Recommendations. The primary recommendation of the IRB is that *the MSR program proceed*.
- **Mars Architecture Strategy Working Group (MASWG) submitted to NASA AA; overview presented to the Mars Panel (Nov. 17)**
- **MEPAG Virtual Meeting #11 (27 January 2021)**
  - Topics: MEP/MSR reorganization, Decadal Survey Mars Panel, HEO and H2M Conference
  - Highlights:
    - Eric Ianson is MEP Director in addition to his other duties; George Tahu is Acting Deputy Director; Michael Meyer is Lead Scientist for MEP and MSR. The next MSR flight elements have been moved out of the MEP, with Jeff Gramling as Director, reporting to the Associate Administrator. M2020 and the future Mars Sample Handling Facility remain in MEP.
    - Regular meetings and communications between MEP/MSR are planned to keep all on the same page
    - Decadal Survey moving forward; several community presentations at Mars Panel open sessions

# Recent MEPAG Activities

- **MEPAG Virtual Meeting #11 (2)**
  - Mars Ice Mapper (MIM) international partners (CSA, JAXA, NASA, ASI) have signed a Statement of Intent (SOI); MOU in work
    - NASA Agency-directed SMD mission in support of Moon to Mars/Humans to Mars strategy
    - May include communication satellite network
    - MEPAG looking forward to hearing more at a future virtual meeting, including release of white paper detailing measurement approach and possible formation of a Mission Design Team (MEPAG finding)
      - MDT could assess ability to meet resource measurement goals and any opportunities for additional measurements to enhance mission science (e.g., ICE-SAG)
  - MIM is a possible example of future dual-purpose science/precursor missions preparing for eventual human missions
    - Agency seeking to outline compelling science goals for human explorers on Mars
    - One example being looked at by a study group is extracting, analyzing and possibly returning ice cores from Mars
    - MEPAG has fielded SAGs on similar topics in the past and looks forward to helping these discussions as appropriate.

# Recent MEPAG Activities

- **MEPAG Virtual Meeting #11 (3)**
  - Significant community discussion regarding potential change in MRO orbit
    - Desire from Mars 2020 to move orbit to a later local time to increase the daily operational period for M2020's surface activities. Such a move would have a significant impact on MRO's primary science.
    - MEPAG originally heard of this potential move in 2019, but the idea was tabled until landing, as M2020 was asked to put together a more detailed rationale.
    - The discussion and decision on whether to direct MRO to a later orbit time will be made in the near future (tentative: March 19; there may be meetings with PSD/SMD after that). MEPAG will not have a meeting prior to this.
    - MEPAG did not hear from M2020 (nor from MRO in detail), and thus the community was not in a position to consider the appropriateness of the trade. However, MEPAG is on the record as noting that while MSR is the highest science priority, it is not the only one; we continue to uphold in our Findings the high value of extended missions to Mars exploration and its community of researchers. Ongoing science missions still have value that should be respected within the context of overall program needs and desires.

# MEPAG VM11 Findings

Mars Sample Return

- MEPAG commends the great effort between the Mars Exploration Program (MEP) and the Mars Sample Return (MSR) program to communicate smoothy and effectively. MEPAG will continue to assess how well the organization, balancing of duties, and lines of communication are working, as the challenges of coordinating a complex, international program arise.

- MEPAG is excited to see the significant progress on the highly complex MSR program. Although concerns of the Independent Review Board (IRB) regarding the schedule and funding profile are valid, the community is encouraged to see MSR move forward.

Mars Exploration Program

- MEPAG encourages NASA to address the important MASWG report requested by the mid-term Decadal review. MEPAG believes that it defines the non-MSR aspects of the MEP and as a standalone report, it should be assessed on its own rather than waiting for the Decadal Survey report. MEPAG is ready to stand up committees that would investigate further the recommendations of this report.

- MEPAG is encouraged by the news that the FY21 budget is sufficient to cover Mars priorities, and is appreciative of headquarters hearing the community's recommendations to focus funding back into extended missions (as per the NASEM report). MEPAG looks forward to seeing the details of the approved operating plan.

NASA Humans to Mars

- MEPAG is excited about the first stages of discussions regarding humans to Mars but is concerned regarding the lack of input the Mars community has had in the initial formation of science objectives for human exploration of Mars. Science community input into HEOMD architectures at the earliest stages will be crucial for coordination and better understanding of knowledge needed for a successful human mission to Mars. MEPAG intends to continue to publicize and support efforts that seek to broaden community input and open discussion, especially early in the process before any major architectural decisions are made.

# Backup slides

# Mars Exploration Program Analysis Group (MEPAG)

## Steering Committee

R. Aileen Yingst
*PSI*
MEPAG Chair

Jeff Johnson,
*JHU/APL*
Past Chair

Wendy Calvin
*UNR*

Scott Hubbard
*Stanford U.*

Sarah Stewart Johnson
*Georgetown*

Don Banfield
*Cornell U.*

Goals Committee Chair

Jen Eigenbrode
*GSFC*

Justin Filiberto
*LPI*
*DEIA Rep*

Kennda Lynch
*LPI*
*DEIA Rep*

Michael Meyer
*NASA HQ*

Rich Zurek
*MPO/JPL*

Dave Beaty
*MSR/JPL*

NEW MEMBER!

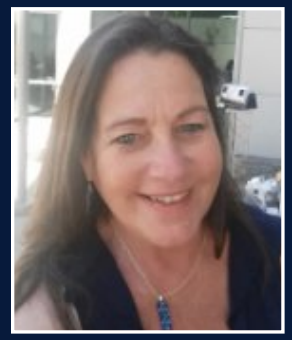
Jake Bleacher
*NASA HQ*

Paul Niles
*JSC*

# Mars Program Office associates

(Jet Propulsion Laboratory)

Brandi Carrier



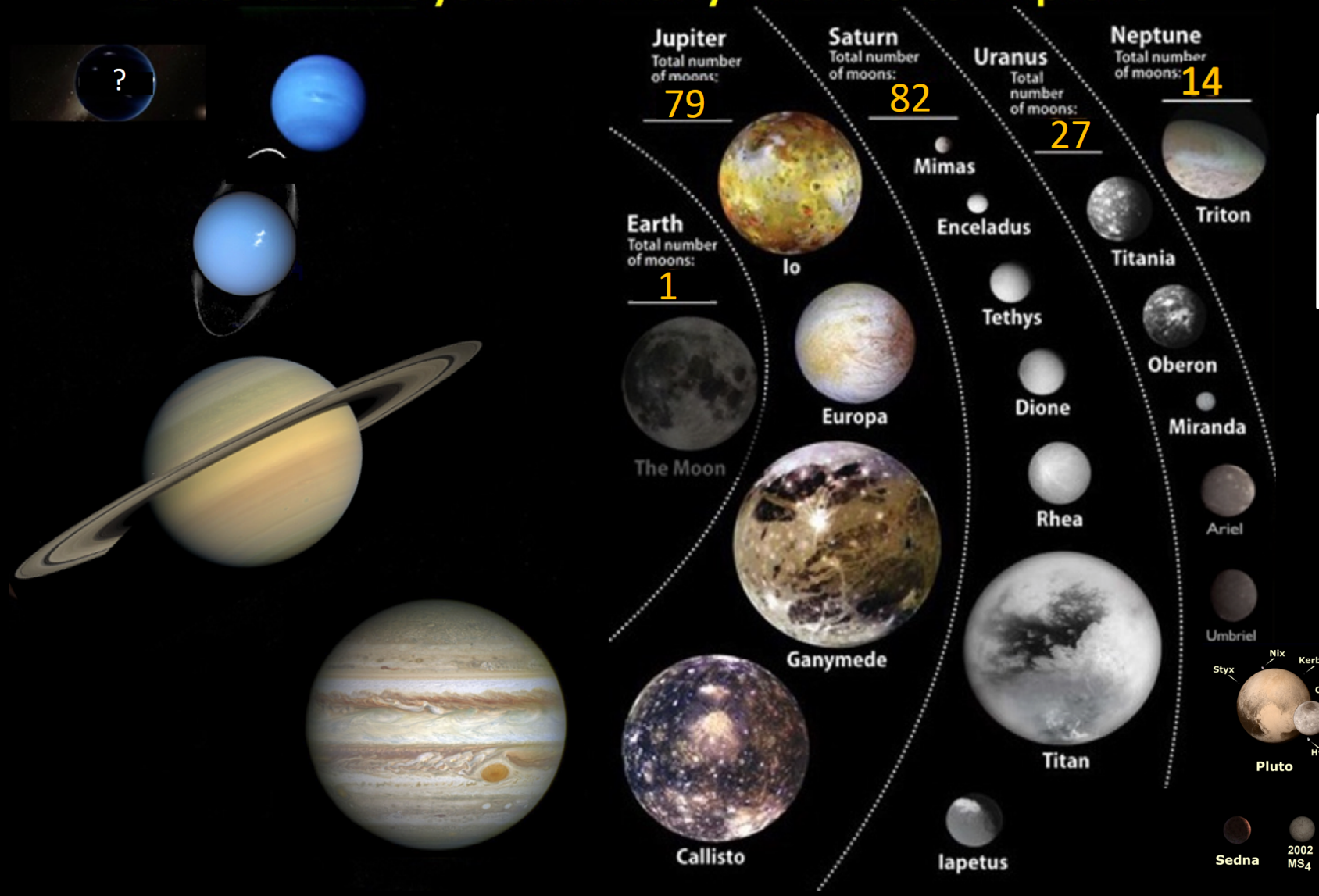
Barbara Saltzberg

Sona Hosseini

# OPAG Update to the Planetary Science Advisory Committee (PAC)

Linda Spilker (JPL), Jeff Moore (NASA ARC), OPAG Co-Chairs, PAC Meeting, 2 March 2021

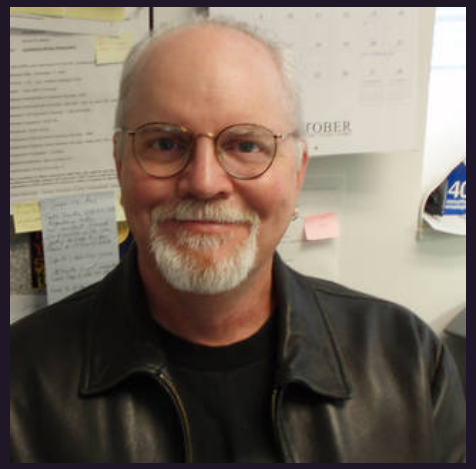
## Outer Solar System: Many Worlds to Explore




OPAG *is* the Comparative Planetology AG

Large KBOs:

# OPAG Steering Committee



Jeff Moore
OPAG Co-Chair
Ames Research Center

Linda Spilker
OPAG Co-Chair
Jet Propulsion Lab

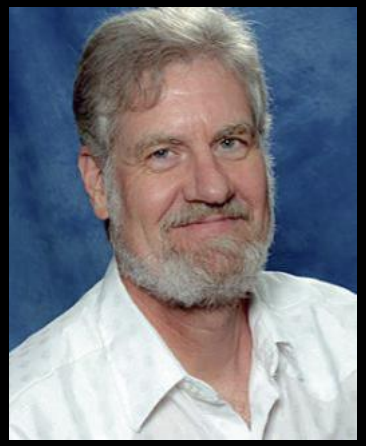
Kennda Lynch
Lunar and Planetary Institute

Kathleen L. Craft
Applied Physics Laboratory

Krista Soderlund
Institute for Geophysics
University of Texas

# OPAG Steering Committee

Morgan Cable
Jet Propulsion Lab



Alfred McEwen
University of Arizona

Kunio Sayanagi
Hampton University

Tom Spilker
Consultant

Abigail Rymer
Applied Physics Lab

# OPAG Steering Committee

Scott Edgington
Jet Propulsion Lab

Amanda Hendrix
Planetary Science Institute

Lynnae Quick
NASA Goddard

Kathleen Mandt
Applied Physics Laboratory

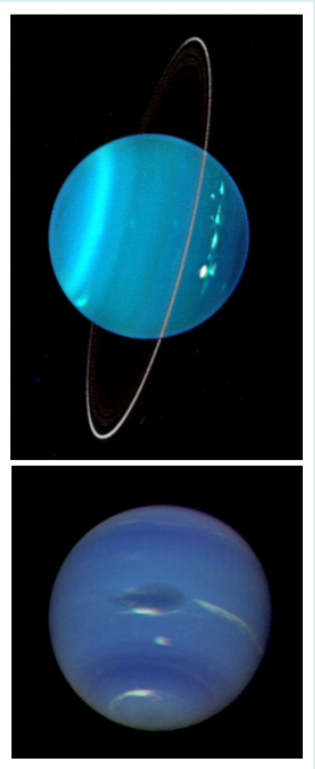
Terry Hurford
Goddard Space Flight Center

Carol Paty
University of Oregon

# Outer Planets Assessment Group (OPAG) Charter

**https://www.lpi.usra.edu/opag/**

- NASA's community-based forum to provide science input for planning and prioritizing outer planet exploration activities for the next several decades
- Evaluates outer solar system exploration goals, objectives, investigations and required measurements on the basis of the widest possible community outreach
- Meets twice per year, summer and winter
  - Next meeting (virtual): Summer 2021
- OPAG documents are inputs to the Decadal Surveys
- OPAG and Small Bodies Assessment Group (SBAG) have Joint custody of Pluto system and other planets among Kuiper Belt Objects




KBO planets

# Recent and Upcoming OPAG-related Meetings

## *Recent Meetings*

- **Town Hall at AGU** (December 2020)
- **OPAG Meeting** (9 – 11 February 2021) (Virtual)
  - Focused on Planetary Science and Astrobiology Decadal Survey
  - Developing Findings from recent meeting

## *Upcoming Meetings*

- **Summer OPAG Meeting** (TBD)
  - Focus on Planetary Science and Astrobiology Decadal Survey

# OPAG New Frontiers 5 Feedback

## *Highlights of OPAG response*

- **Cost Cap Scope:** OPAG concurs with excluding Phase E and launch vehicle costs from the NF-5 mission cost
- **Cost Cap Amount:** OPAG recommends that NASA maintain the cost cap at the same level ($1.1B in FY22$) for NF-5
- **Continued development of a healthy planetary science community:**
  - OPAG advocates that evaluation criteria for NF5 proposals should include factors that consider how proposed missions would foster an interdisciplinary, diverse, equitable, inclusive and accessible community

# OPAG Concerns

- **Community Involvement in Decadal Survey**: OPAG is concerned about transparency and opportunities for community feedback during the current decadal process. OPAG strongly encourages more options for audience questions during open sessions of all panels of the Decadal Survey, and publication of the meeting materials in a timely manner.
- **Dragonfly 2-year launch slip and impact to New Frontiers 5 schedule**: Recent slips to the Dragonfly launch date appear to imply a lower priority for Dragonfly than for other missions. Moving the Dragonfly launch date later will soon begin to impact the New Frontiers 5 budget and launch dates, a growing OPAG concern. What can be done to avoid slipping the Dragonfly launch a third time?

# OPAG Concerns

- **Controlling Cost Growth for Flagship Missions:** NASA has TWO flagships (Clipper and MSR) under development and scheduled for launch in the mid 2020's. How does NASA plan to control cost growth on BOTH of its flagship missions? This is important because problems with flagships can have a large impact on the rest of the planetary portfolio.
- **Flagship Priorities for the next decade:** It is not clear how MSR will be prioritized relative to future flagship missions over the next decade. Given the number of scientifically exciting future flagship missions, it is important that all candidate missions be prioritized together if they fall within the next decadal survey.


# Mapping and Planetary Spatial Infrastructure Team (MAPSIT)

**Report to Planetary Advisory Committee (PAC)**
**March 1–2, 2021 Meeting**

# Who we are: MAPSIT Steering Committee

Brad Thomson (Univ. Tennessee), *Chair as of Jan 2021*

Julie Stopar (LPI), *Vice Chair*

Brent Archinal (USGS)

Ross Beyer (SETI/NASA Ames)

Dani DellaGiustina (Univ. Arizona)

Caleb Fassett (NASA/Marshall), *retiring 2021*

Lisa Gaddis (LPI), *retiring 2021*

Sander Goossens (NASA Goddard)

Justin Hagerty (USGS)

Trent Hare (USGS)

Jay Laura (USGS)

Pete Mouginis-Mark (Univ. Hawaii)

Andrea Naß (DLR, Germany)

Alex Patthoff (PSI)

Jani Radebaugh (Brigham Young Univ.), *past Chair*

Sarah Sutton (Univ. Arizona)

David Williams (Arizona State Univ.)

# What we do: MAPSIT Roadmap

"The MAPSIT community is comprised of all planetary scientists with interest in planetary spatial data. This roadmap represents a summary of the spatial data-related topics considered to be of highest current priority in the coming five-year period (2019 to 2023). The overarching theme is ***to ensure that planetary spatial data meet the broadest needs of the planetary science community.***"

https://www.lpi.usra.edu/mapsit/roadmap/

# MAPSIT Findings (1/4)

MAPSIT endorses a recent knowledge inventory of foundational data products in planetary science (Laura and Beyer, 2021), and will interface with AGs to review the paper, consider next steps, and potentially incorporate into their own findings, especially with respect to funding prioritization.

Full citation: Laura J. R. and R. A. Beyer (2021) Knowledge Inventory of Foundational Data Products in Planetary Science, *The Planetary Science Journal, 2*(18), doi:10.3847/PSJ/abcb94.

# MAPSIT Findings (2/4)

## Progress on PSDI creation (Planetary Data Spatial Infrastructure)

- In line with MAPSIT's Roadmap, MAPSIT applauds the creation of a part of preliminary PSDI for Io (Williams et al., 2021 LPSC).
- MAPSIT encourages the continued development of a Europa PSDI, which is currently underway.

A reminder from Laura et al. (2018) ESS:

Spatial data infrastructure (SDI) is the enabling collection of spatial data users, data interoperability agreements, policies and standards, data access mechanisms, and the spatial data themselves (Rajabifard et al., 2002). In the context of planetary science, spatial data are any data with a spatial component including visible and infrared sensor data, radar data, spectrometer data, and even data such as the Apollo samples that include collection location information.

# MAPSIT Findings (3/4)

MAPSIT encourages the creation of a PSDI for the Moon, in collaboration with LEAG, LSIC, and other appropriate parties.

- With numerous lunar efforts from NASA, the commercial sector, and other space agencies underway, now is the ideal time to establish a lunar PSDI that benefits all.
- Similar to MAPSIT finding presented Nov. 2020.
- Note the workload required to create a lunar PSDI will be non-trivial; will likely have to proceed as a funded effort rather than staffed via volunteers on a best-effort basis

# MAPSIT Findings (4/4)

MAPSIT appreciates the establishment of an Independent Review Board (IRB) for the Planetary Data Ecosystem (PDE).

- The IRB's stated goals are to define the full environment, identify missing or overly redundant elements, and provide findings and prioritized, actionable recommendations for PSD's long-term planning in support of the PDE, all of which are aligned well with MAPSIT's objectives.

# Extraterrestrial Materials Analysis Group (ExMAG)

Barbara Cohen, Chair

Barbara.A.Cohen@nasa.gov

March 2021

# Extraterrestrial Materials Analysis Group (ExMAG)

~~CAPTEM~~

## ExMAG

- Community-based analysis & advocacy
- ExMAG members and subcommittees will continue providing expertise and analysis on collection, allocation, and curation activities (Spring meeting)
- Expand its AG role to better serve the sample-analysis community; e.g., discuss initiatives, reports, missions, findings and studies as requested or initiated (Fall meeting)

## Astromaterials Allocation Review Board (AARB)

- Allocations are being run as traditional NASA Review Panels separate from the AG function
- Review panels are initiated by the Astromaterials Curator and supported by NRESS
- Requests will be continue to be submitted through email
- The ExMAG subcommittees contain substantial subject-matter expertise that the Curator may draw on when forming a Review Panel

# ExMAG structure

**ExMAG STEERING COMMITTEE**

**ExMAG Chair**

**Astromaterials Curator**

**NASA HQ Liaison**

**Exploration Hardware Subcommittee**
Space-exposed hardware collections, future hardware
*vacant*

**Facilities and Informatics Subcommittee**
Sample curation facilities, databases, and catalogs
*Sam Lawrence*

**Chair:**
Barbara Cohen (GSFC)

**Members:**
Hope Ishii (UH), Vice-Chair
Elizabeth Rampe (JSC), Secretary
Jessica Barnes (U of Arizona)
Jemma Davidson (ASU)
Justin Filiberto (LPI)
Jon Friedrich (Fordham)
Juliane Gross (Rutgers)
Lydia Hallis (U Glasgow)
Munir Humayun (FSU)
Larry Nittler (CIW)
Caroline Smith (NHM London)
Rhonda Stroud (NRL)
Allan Treiman (LPI)

*New members needed in 2021*

**Lunar Sample Subcommittee**
Apollo samples, Artemis sample planning

**Mars Sample Subcommittee**
MMX and Mars Sample Return planning

**Microparticle Subcommittee**
Cosmic Dust, Stardust mission, microparticle impacts

**Asteroid Subcommittee**
Hayabusa, Hayabusa-2, OSIRIS-Rex

**Meteorite Subcommittee**
Antarctic meteorites

**Genesis Subcommittee**
Genesis mission
Larry Nittler

# ExMAG Activities in 2021

- Housekeeping – chair transition, new charter approval, new name, subcommittee realignment, membership review, meeting planning
- Subcommittees considering expanded scope of activities
- Budget planning for the next three years
- Working on updating the Web Site
- Meeting planning
  - Town Hall last week – Feb 25
  - Spring Meeting, Wed. - Thurs., April 7-8
  - Fall meeting

# ExMAG Town Hall

- Virtual meeting, Feb. 25
- NASAAnalysis Groups and changes – Dr. Jeff Grossman, NASA HQ
- Updated Sample Allocation process – Dr. Francis McCubbin, NASA Astromaterials Curator
- Extraterrestrial Materials Analysis Group (ExMAG) activities, meetings, and membership – Dr. Barbara Cohen, ExMAG Chair
- Community Q&A

# ExMAG Spring Meeting

- Virtual / online
- Wed. - Thurs., April 7-8, 1 pm – 5 pm EDT
- NASA HQ briefing, New Frontiers 5 sample return mission language, Mars MSPG2 update
- NASA JSC organizational and facilities reports
- Astromaterials Curation & Allocation reports
- Advanced Curation topics: ANGSA consortium model, Microbial ecology of Curation clean labs
- Chang'e 5 sample return, Artemis curation planning, and Artemis III SDT
- Discussion of ExMAG findings to be brought to PAC
- Agenda will be posted soon

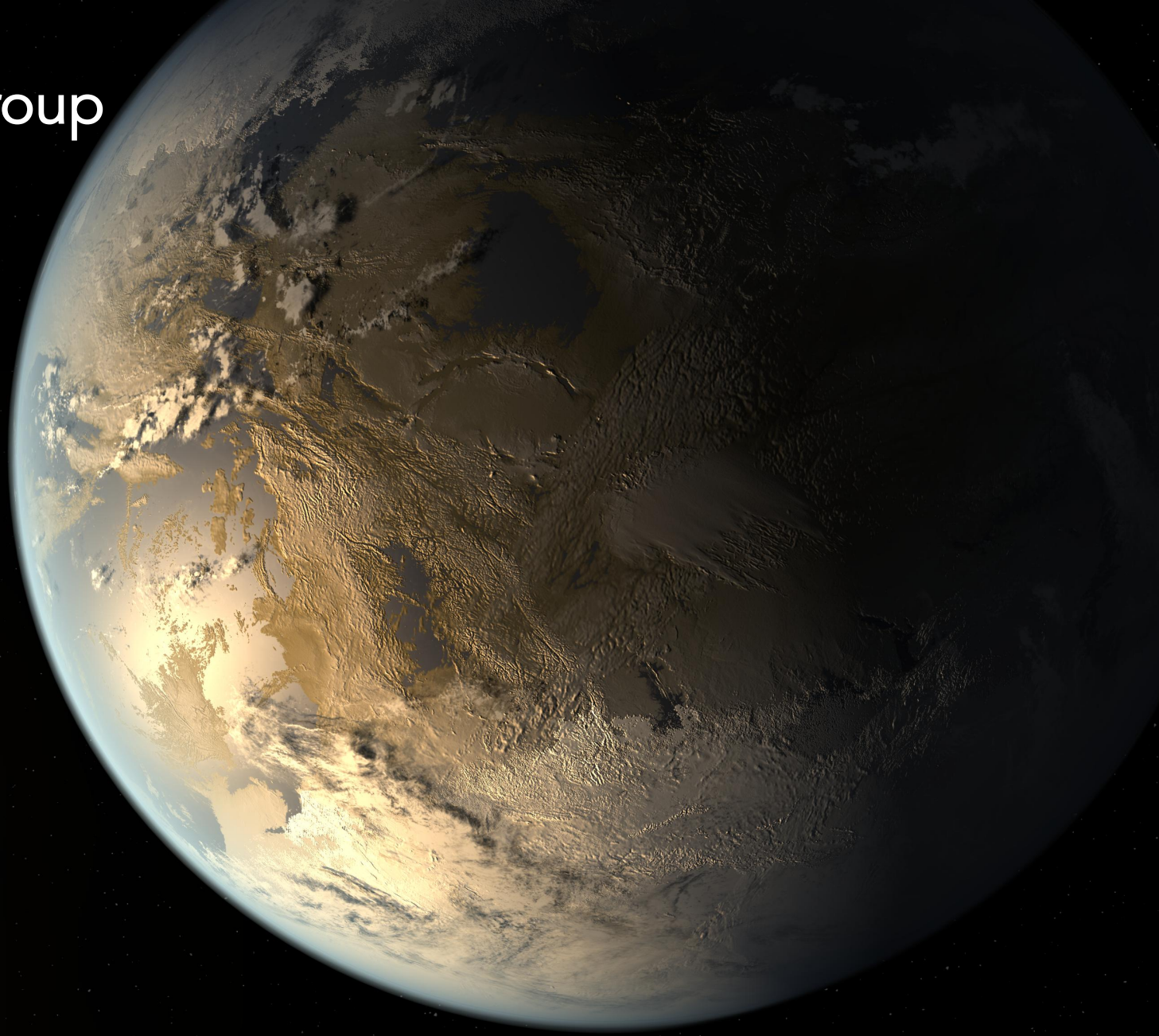

# ExMAG Fall Meeting, Sept-Oct timeframe

- Very likely to be virtual in 2021
- This meeting will be focused on community needs for missions, facilities, etc.
- Potential Topics might include:
  - Current sampling mission updates: ORex, MMX, Hayabusa 2, Chang'e 5
  - Mars Sample Return updates from HQ, Perseverance sampling update, contamination and curation planning for MSR
  - Artemis III sampling, tools, curation planning
  - New Frontiers and Discovery mission proposals / PMCS studies
  - Sample-handling subsystems for sampling - current state of the art, upcoming missions/instruments (e.g. VIPER, SAMPLR, PlanetVac, Prime-1 drill, commercial regolith collection)
  - Sample-return analysis facilities - are we ready for ORex and Artemis? NASA briefing on Planetary Major Equipment and LARS program stats
  - Early-career contributions (lightning talks or special topics)
- We'll put out a call for community contributions

# ExMAG Membership

- ExMAG members provide expertise and conduct studies relevant to sample science and future mission, curation, and analysis plans, and communicate findings to the planetary science community and to NASA.
- ExMAG Subcommittee members bring specialized knowledge and expertise to advise NASA on specific curatorial collections and issues.
- Appointments are for three-year terms, such that roll-off is staggered.
- ExMAG seeks to have membership as diverse as the community in career stage, demographics, type of employer, and area of expertise.
- We are currently seeking two regular members (Exploration Hardware, Facilities and Informatics) and three Subcommittee members (1 lunar, 2 meteorite)
- A call will come out for applications *soon* and will appear on the website
- Application deadline March 31; applicants should be prepared to attend Spring Meeting April 7-8

# Exoplanet Program Analysis Group (ExoPAG) Report:



Michael Meyer (ExoPAG EC Chair)
March 2nd, 2021.

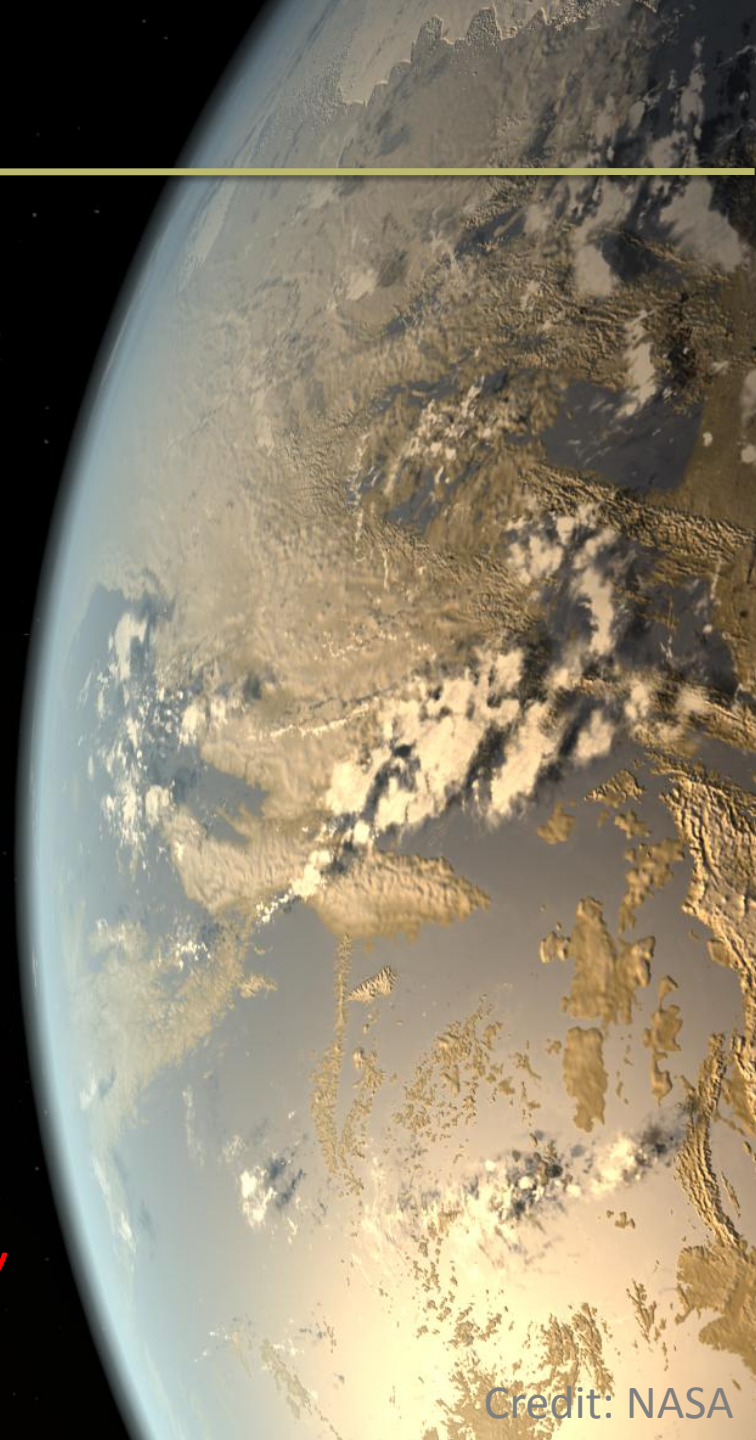
Planetary Science Advisory Committee

Credit: NASA

# ExoPAG Executive Committee

| | |
|---|---|
| Michael Meyer (Chair) | University of Michigan |
| Tom Barclay | University of Maryland |
| Natasha Batalha | NASA-Ames |
| Jacob Bean | The University of Chicago |
| Jessie Christiansen | NExScI/Caltech |
| Rebecca Jensen-Clem | UC-Santa Cruz |
| John Debes | Space Telescope Science Institute |
| Tiffany Kataria | JPL/Caltech |
| Josh Pepper | Lehigh University |
| Dmitry Savransky | Cornell |
| Laura Schaefer | Stanford University |
| Vikki Meadows (Past Chair) | University of Washington |
| Hannah Jang-Condell (ExEP DS) | NASA HQ, Executive Secretary |
| Douglas Hudgins (Astrophysics) | NASA HQ |
| Doris Daou (Planetary Liaison) | NASA HQ |
| Richard Eckmann (Earth Liaison) | NASA HQ |
| Gaylan Fowler (Heliophys Liaison) | NASA HQ |

*Selection process for new members underway*

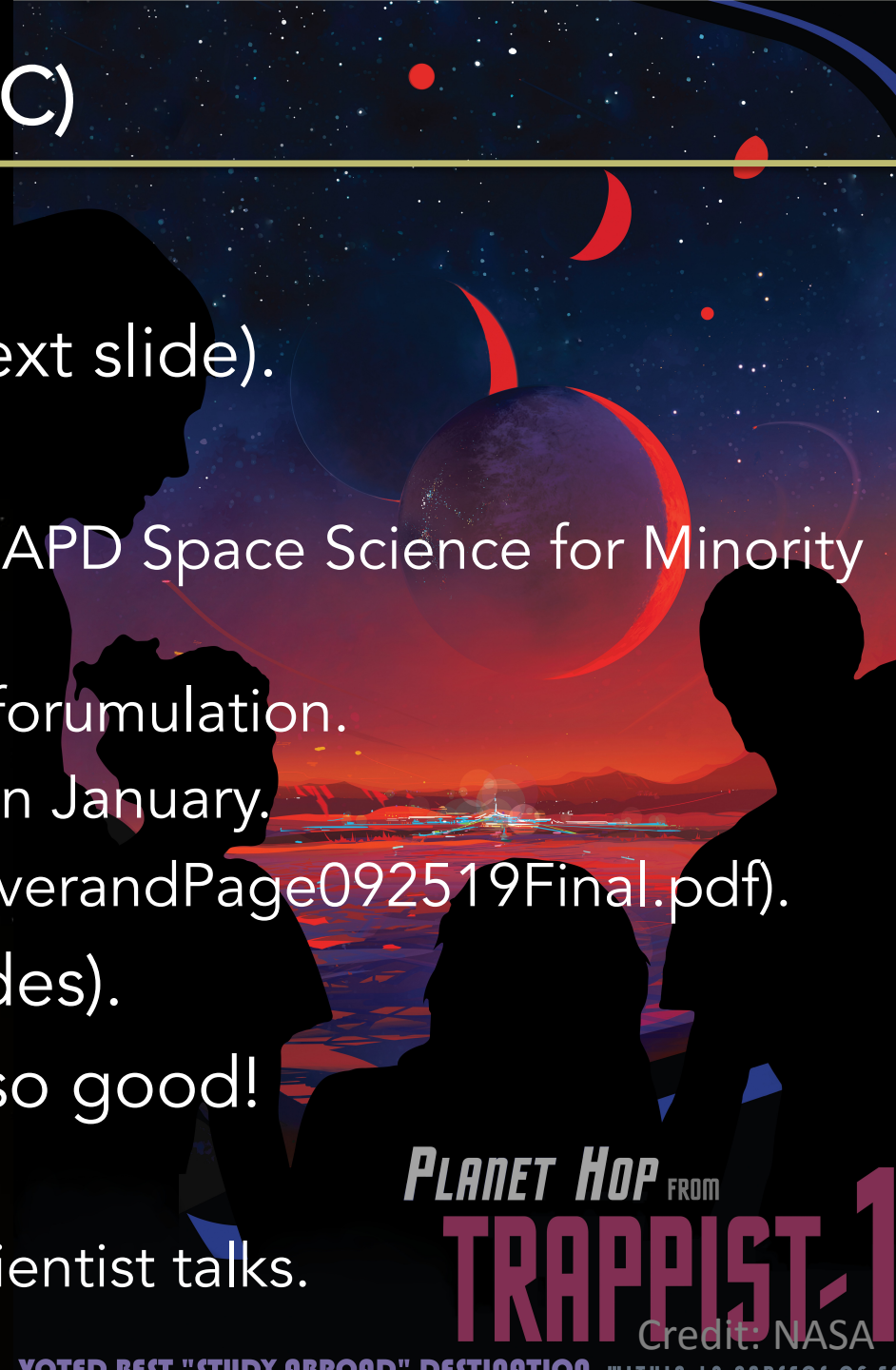


Credit: NASA

# ExoPAG Recent Activities (since last PSAC)

- Community forum prepared for ExoPAG23 (next slide).
- APD Cross PAG activities:
  - AAS Special Session on Barriers to Participation in APD Space Science for Minority Serving Institutions.
  - Cross PAG SAG on URM in APD Space Science in forumulation.
  - Review of APD Biannual Tech Gap Review at AAS in January.

  (https://apd440.gsfc.nasa.gov/images/tech/ABTRCoverandPage092519Final.pdf).
- ExoPAG 23 Jan. 5-6 before AAS  (see next slides).
- First Exoplanet Explorers events held - so far so good!
  - Over 100 participants.
  - Both senior scientists and mentoring plus junior scientist talks.



# ExoPAG Community Forum –Held December 15.

*Describe scope of ExoPAG analyses.*

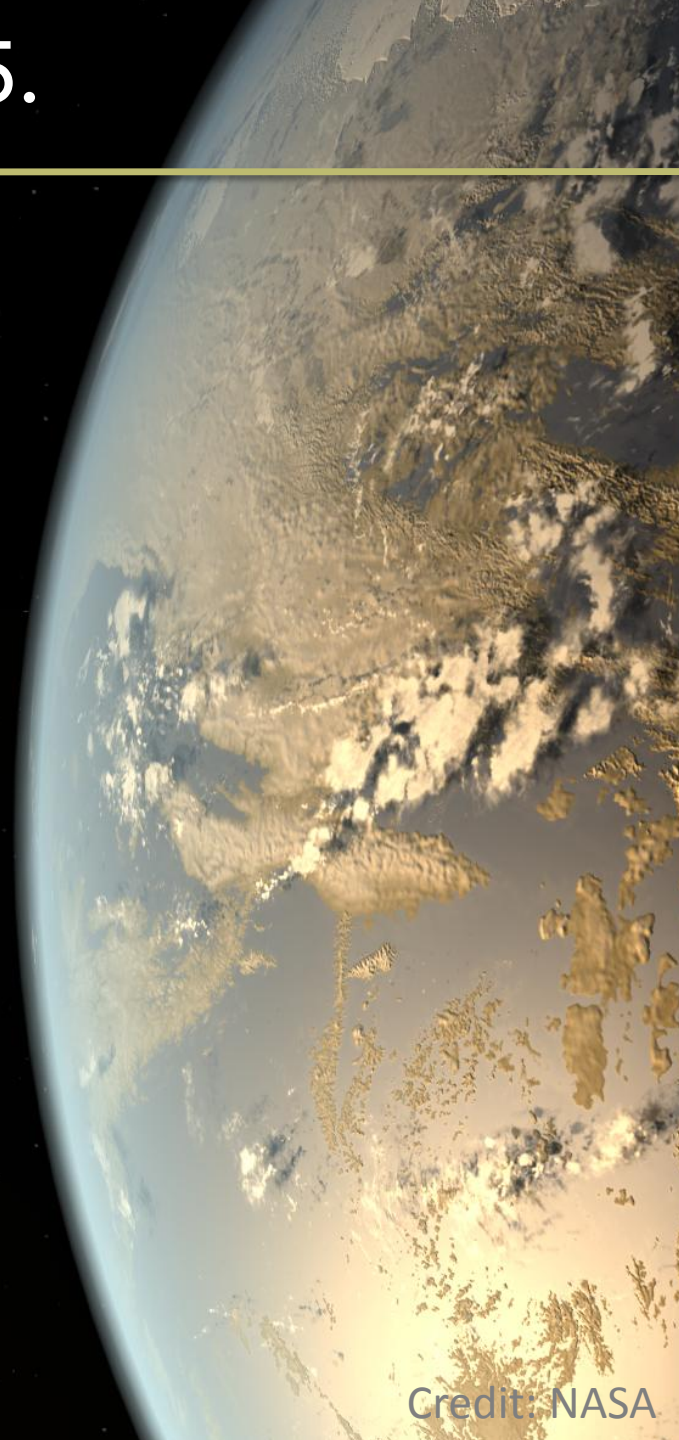
*Review past "Findings".*

*Discuss proposed finding:*

*On the value of investing in interdisciplinary exoplanet science of scale over longer periods of performance (full text shared through ExoPAG Announcement).*

*Solicit community feedback and proposals for future findings.*

*Pre-meeting input and process to down-select fidings for votes.*



Credit: NASA

# ExoPAG 23 January 5-6, 2021 Virtual

*Solar System / Exoplanet Synergies Mini-Symposium!*

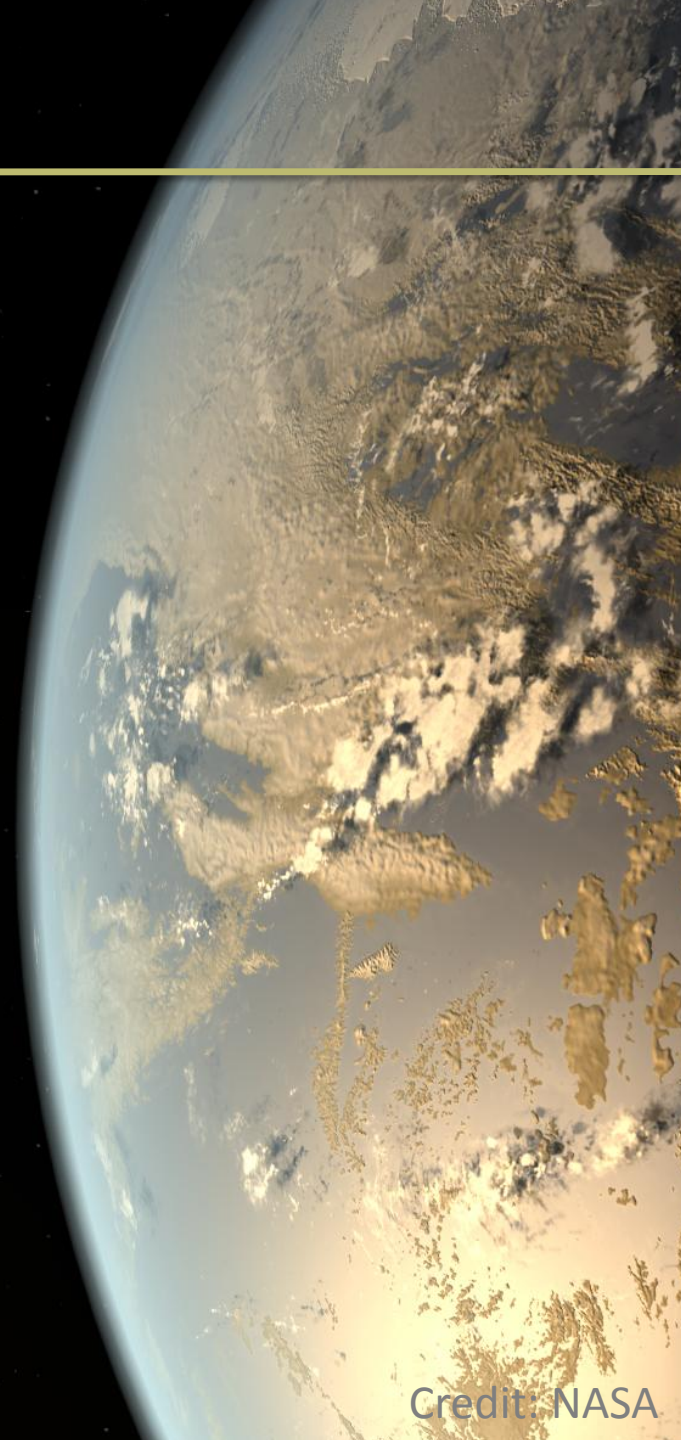
- *SIG3 Update (V. Meadows).*
- *talks on Venus (M. Wong) and Ice Giants (K. Mandt).*
- *Habitable Worlds Meeting Pre-Meeting Update (C. Unterborn)*
- *Early-career scientist presentations.*
- *Panel Discussion (*Ty Robinson, Erin May, Laura Mayorga, Giada Arney).

*ExEP Program Topics (HQ, Program Office at JPL, NExSci)*

*Science Updates*

- *TESS Mission Updated and program notes.*
- *Microlensing Review.*
- *FARSIDE overview (lunar radio interferometer).*
- *Earth Science Exoplanet Synergies (HQ overview and science talk)*

*Business Meeting (cancelled!  Conducting on-line poll this week on finding).*



Credit: NASA

# Current Status of SAGs and SIGs:

https://exoplanets.nasa.gov/exep/exopag/overview/

| Close Year | SAG or SIG | Title | Lead |
|---|---|---|---|
| 2020 | SAG 19 | Exoplanet imaging signal detection theory and rigorous contrast metrics (closeout expected March 16 APAC meeting) | Mawet & Jensen-Clem |
| ---- | SIG 2 | Exoplanet Demographics (new report on database needs) | Christiansen & Meyer |
| ---- | SIG 3 | Exoplanet Solar System Synergies (**Habitable Worlds last week!).** | Meadows & Mandt |
| ---- | SAG 21 | Stellar Contamination on Transit Spectra (**Community Symposium!)** | Rackham &Espinoza (Barclay) |
| ---- | SAG 22 | Exoplanet Host Properties Database (report in summer) | Pepper, Stark, & Hinkel |

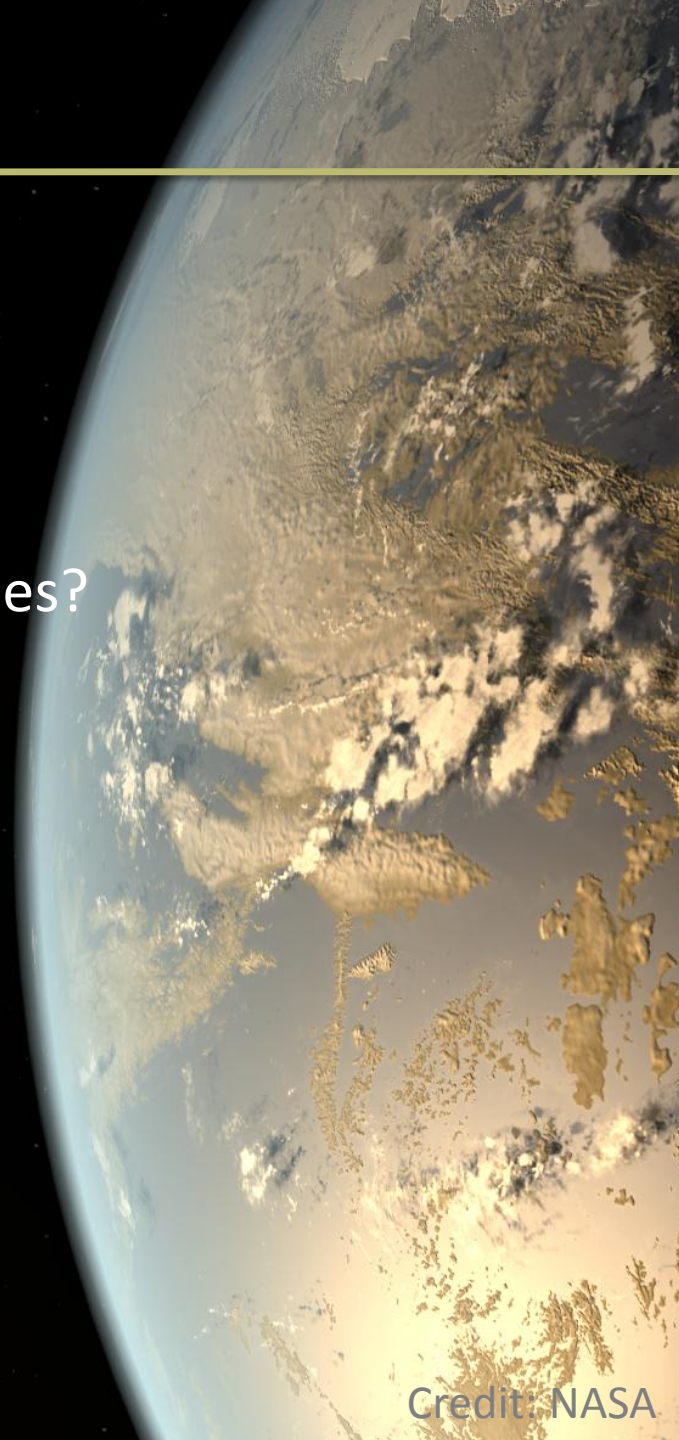
*All are very active and open to participation if any community members would like to know more!*

# Upcoming Activities:

1. Initiatives under consideration:
   - Ground- and space-based direct imaging synergies?
   - Review status of debris disk knowledge for imaging planets?
   - Common standards for publishing/archiving exoplanet discoveries?
2. React to NAS Decadal Survey Astronomy & Astrophysics.
3. Organize ExoPAG 24:

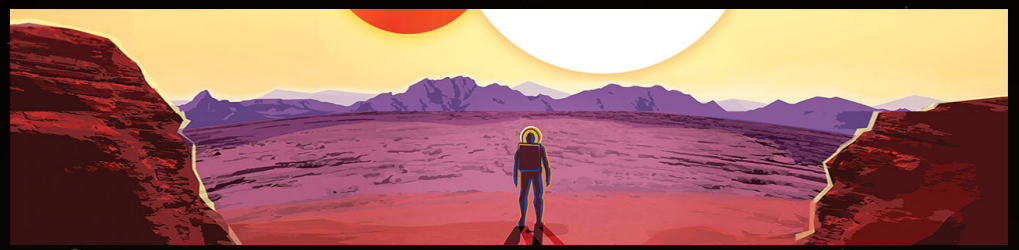
   Two-day 12-5 pm EST between June 14-18 or June 21-25

*Question for PSAC: There have not been recent planetary science proposals for APD balloon programs. Should there have been?*



Credit: NASA

# Back-up



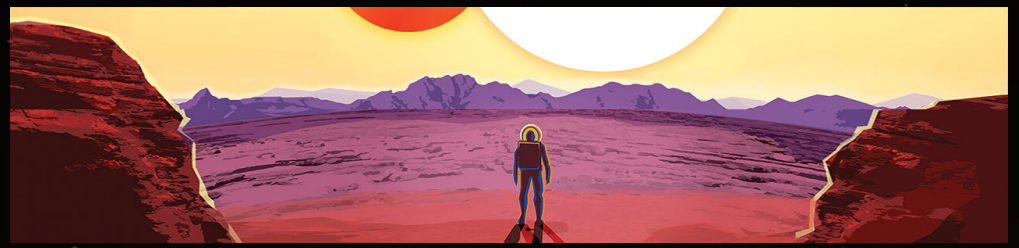
Credit: NASA

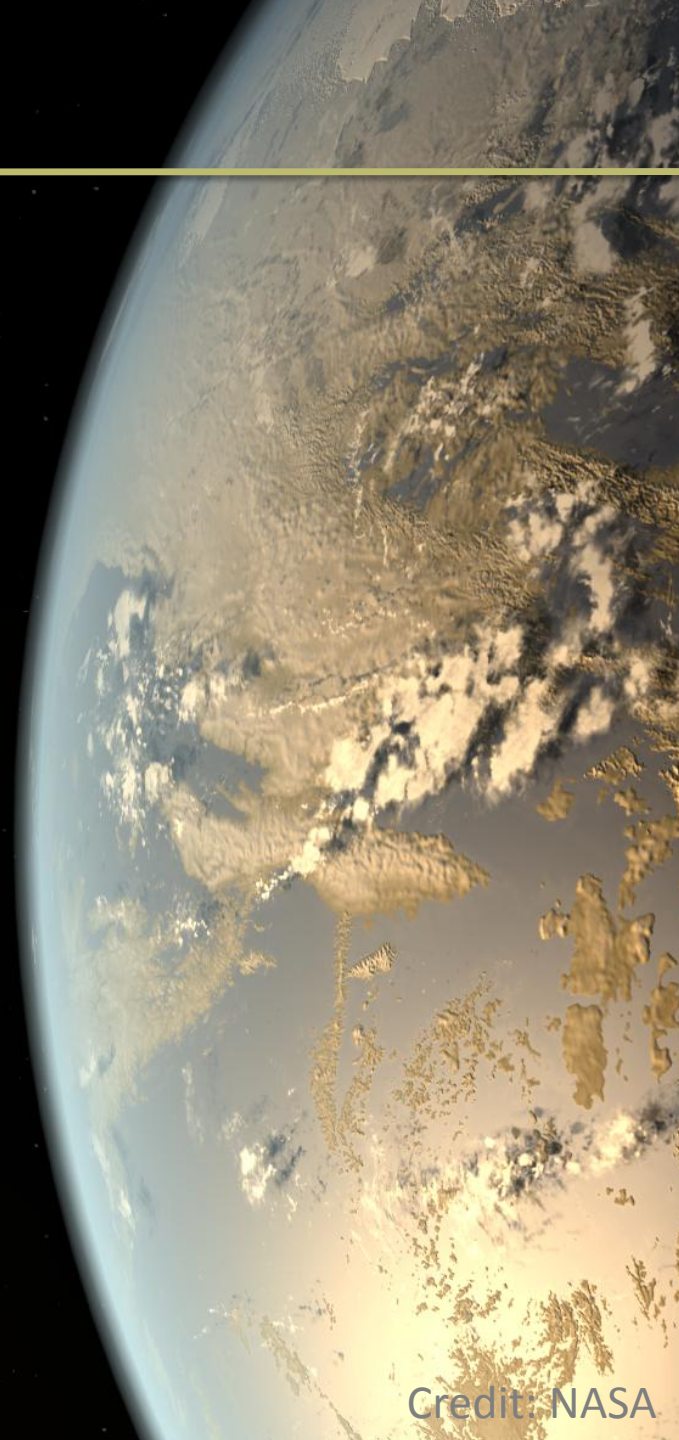
# Exoplanet Explorers Program Launched!

Steering Committee (all are members of ExoPAG EC):
T. Kataria (JPL), N. Batalha (NASA-Ames), J. Christiansen (IPAC), & J. Pepper (Lehigh)

Early career (grad students & postdocs) cohort for speakers series.
Half-hour monthly seminar series.
Stipend for presentation and weekly interaction with cohort.
Monthly professional development interaction with senior scientists in the field.
Additional professional development workshops to be decided by cohort.
Proposals due November 5, 2020! To be selected by ExoPAG EC.
Pilot Program January-June 2021.

For more information: https://exoplanets.nasa.gov/exep/exopag/exoexplorers/





Credit: NASA